



TIMBERLAKE ROAD CORRIDOR IMPROVEMENT STUDY

Campbell County and City of Lynchburg, Virginia

Date: September 2019





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Prepared for



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List of Acronyms

- AADT - Annual Average Daily Traffic
- AASHTO - American Association of State Highway and Transportation Officials
- CLRP - Constrained Long Range Plan
- CVMPO - Central Virginia Metropolitan Planning Organization
- GIS - Geographic Information System
- HCM - Highway Capacity Manual
- HSIP - Highway Safety Improvement Program
- LOS - Level of Service
- MOE - Measure of Effectiveness
- MPO – Metropolitan Planning Organization
- PDO - Property Damage Only
- PHF - Peak Hour Factor
- RNS - Roadway Network System
- RRFB - Rapid Rectangular Flashing Beacon
- RSA - Roadway Safety Assessment
- SWG - Study Work Group
- SYIP - Six-Year Improvement Program
- TMC - Turning Movement Count
- v/c – Volume-to-Capacity Ratio
- VDOT - Virginia Department of Transportation

Table of Contents

List of Acronymsii

Introduction1

 Background and Purpose of the Study1

 Study Work Group1

 Study Area1

Inventory and Data Collection3

 General Description of Study Area3

 Land Use4

 Other Relevant Plans and Studies4

 Geometric Characteristics5

 Access Management Spacing5

 Crash Analysis7

 Summary of Overall Study Area Crashes7

 Traffic Data14

 Field Review Observations14

 Daily Traffic Demand14

 Peak Hour Determination15

 Heavy Vehicle Percentages15

 Seasonal Adjustment Factors15

 Traffic Volume Balancing16

 Speed Data16

Existing Conditions23

 Traffic Analysis Assumptions23

 Traffic Analysis Results23

 Delay and Level of Service23

 Queuing24

Traffic Forecasting31

 Traffic Growth Rate Development31

 Relevant Development Proposals31

 Historical Traffic Demand31

 Regional Travel Demand Model – Traffic Projections31

 Transportation Analysis Zone Population Projections32

 VDOT Statewide Planning System32

 Traffic Growth Rate Application32

 Project Traffic Volumes32

No-Build Conditions36

 Traffic Analysis Assumptions36

 Traffic Analysis Results36

 Delay and Level of Service36

 Queuing37

Improvement Screening and Analysis44

 Concept Development44

 Address Safety Issues44

 Improve Traffic Operations45

 Upgrade to Current Access Management Standards46

 Multimodal Considerations46

Preferred Build Conditions (2030)47

 Traffic Analysis Assumptions47

 Traffic Analysis Results47

 Delay and Level of Service47

 Queuing48

Conceptual Design, Costs, and Schedules55

 Conceptual Design55

 Planning-Level Cost Estimates55

 Schedule Estimates55

Project Advancement56

 Prepare Projects for Advancement56

 Apply for Funding56

Table of Figures

Figure 1 – Study Area2

Figure 2 – Baseline Conditions Assessment Summary.....3

Figure 3 – Illustration of The Relationship Between Spacing Standards6

Figure 4 – Timberlake Road Fatal and Injury Crash Hotspots8

Figure 5 – Timberlake Road Pedestrian Crashes.....9

Figure 6 – Eastbound Timberlake Road Crash Type Summary10

Figure 7 – Westbound Timberlake Road Crash Type Summary.....11

Figure 8 – Timberlake Road Crash Histograms (Crash Type) from MP 1.75 to MP 3.5012

Figure 9 – Timberlake Road Crash Histograms (Crash Type) from MP 3.50 to MP 5.1513

Figure 10 – Daily Traffic profile14

Figure 11 – Daily Truck Traffic.....15

Figure 12 – Existing (2016) Turning Movement Counts.....17

Figure 13 – Existing Timberlake Road Lane Configurations.....20

Figure 14 – Existing LOS and Delay25

Figure 15 – Existing Queuing.....28

Figure 16 – SPS Linear Growth Rates (2014 – 2035).....32

Figure 17 – Future (2030) Turning Movement Counts33

Figure 18 – Future (2030) LOS and Delay38

Figure 19 – Future (2030) Queuing41

Figure 20– Build (2030) LOS and Delay49

Figure 21 – Build (2030) Queuing.....52

Table of Tables

Table 1 – Minimum Spacing Standards For Commercial Entrances, Intersections, and Median Crossovers5

Table 2 – Spacing Between Signalized Intersection And Signalized Intersection Along Timberlake Road6

Table 3 – Spacing between Unsignalized Intersection/Full Median Crossover and Signalized Intersection/Unsignalized Intersection/Full Median Crossover Along Timberlake Road.....6

Table 4 – Spacing between Full Access Entrance or Directional Median and Any Intersection, Full Access Entrance, or Median Crossover Along Timberlake Road.....7

Table 5 – Yearly Crash Summary by Crash Severity.....7

Table 6 – Peak Hour Determination15

Table 7 – Vehicle Classifications15

Table 8 – Level of Service Criteria.....23

Table 9 – Existing (2016) Signalized Delay and LOS.....23

Table 10 – Existing (2016) Unsignalized Delay and LOS.....23

Table 11 – VDOT Historical Traffic Data.....31

Table 12 – TDM Linear Growth Rate Projections32

Table 13 – Future (2030) Signalized Delay and LOS.....36

Table 14 – Future (2030) Unsignalized Delay and LOS37

Table 15 – Future (2030) Signalized Delay and LOS.....47

Table 16 – Future (2030) Unsignalized Delay and LOS47

Table 17 – Planning-Level Cost Estimates.....55

Table 18 – Schedule Estimates55

Appendix

Appendix A – Data Collection

Appendix B – Existing Conditions

Appendix C – No-Build Conditions

Appendix D – Concept Screening

Appendix E – Build Conditions

Appendix F – Selected Concept Sketches

Appendix G – Project Summary Sheets

Appendix H – Planning Level Cost Estimates

Introduction

Background and Purpose of the Study

The purpose of this study, the *Timberlake Road (US 460 Business) Corridor Improvement Study*, was to identify the extent of the operational and safety challenges on the corridor and to develop potential transportation solutions. This study evaluated the existing and projected future conditions on Timberlake Road between Waterlick Road (Route 622) and Leesville Road; identified deficiencies in the road network; formulated alternatives and corrective measures; computed planning level cost estimates; and prioritized recommended improvements along Timblerlake Road.

Study Work Group

A study work group (SWG) was formed for the *Timberlake Road (US 460 Business) Corridor Improvement Study* to capture input from local stakeholders throughout the study process and to shape the development of improvement concepts. The SWG provided institutional knowledge of the corridor, reviewed study methodologies, provided input on key assumptions, and reviewed proposed improvements developed through the study process. The Timberlake Road Corridor Improvement Study SWG included members representing the following organizations:

- Virginia Department of Transportation (VDOT)
- City of Lynchburg
- Campbell County
- Central Virginia Metropolitan Planning Organization (CVMPO)
- Kimley-Horn and Associates
- Engineering Planning Resources (EPR)

Study Area

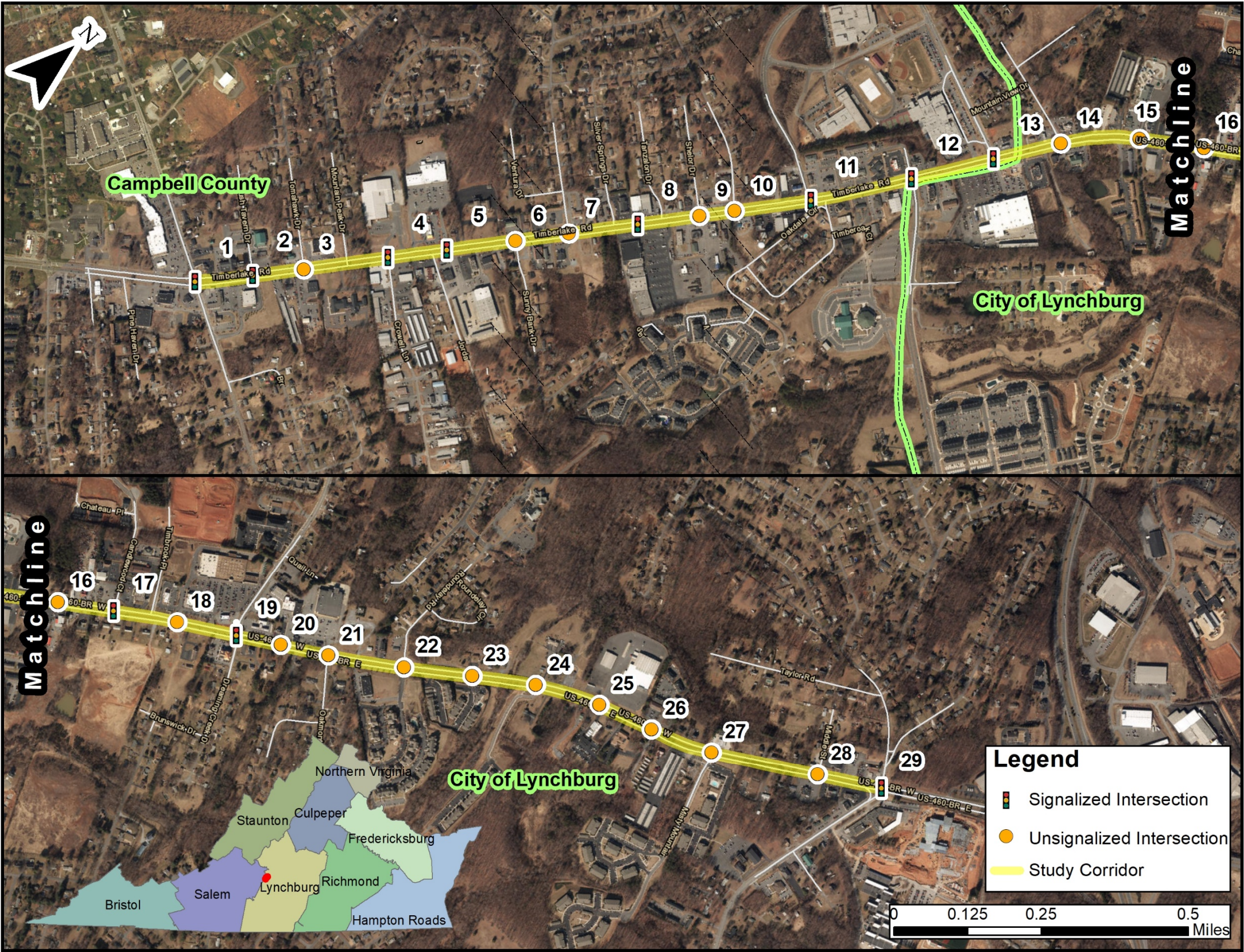
The study area for the Timberlake Road (US 460 Business) corridor is approximately 3 miles in length, extending between Waterlick Road (Route 622) and Leesville Road in a general east/west direction. On the west end, the Timberlake Road corridor is in Campbell County, and extends east into the City of Lynchburg. Timberlake Road is a four-lane divided *primary* highway that directly supports a significant commercial corridor. Primary highways are either divided highways or two-and-three lane undivided highways allowing uncontrolled access and are designed for both “through” and local traffic. Within the City of Lynchburg, Timberlake Road is functionally classified as an urban arterial. **Figure 1** illustrates the corridor study area.

The study area includes the following 29 at-grade signalized and unsignalized intersections:

1. Timberlake Road at Waterlick Road (signalized)
2. Timberlake Road at Brush Tavern Drive (signalized)
3. Timberlake Road at Tomahawk Drive (unsignalized)
4. Timberlake Road at Crowell Lane (signalized)
5. Timberlake Road at Southwood Village (signalized)
6. Timberlake Road at Sunny Bank Drive (unsignalized)
7. Timberlake Road at Powtan Drive (unsignalized)
8. Timberlake Road at Big Lots/Carpet One Entrance (signalized)*
9. Timberlake Road at Shelor Drive (unsignalized)
10. Timberlake Road at Beechwood Drive (unsignalized)
11. Timberlake Road at Enterprise Drive/Oakdale Circle (signalized)

12. Timberlake Road at Greenview Drive (signalized)
13. Timberlake Road at Laxton Road (signalized)
14. Timberlake Road at Wood Road (unsignalized)
15. Timberlake Road at Knollwood Townhomes/Putt Putt Entrance (unsignalized)
16. Timberlake Road at Charlie’s Chicken/Hooper Plumbing Supply Entrance (unsignalized)
17. Timberlake Road at Candlewood Court (signalized)
18. Timberlake Road at TGI Friday’s/Bojangles Entrance (unsignalized)
19. Timberlake Road at Old Graves Mill Road/Dreaming Creek Drive (signalized)
20. Timberlake Road at Hedges Insurance Agency Entrance (unsignalized)
21. Timberlake Road at Oakmont Circle (unsignalized)
22. Timberlake Road at Roundelay Road (unsignalized)
23. Timberlake Road at Timber Ridge Apartments Entrance (unsignalized)
24. Timberlake Road at Timber Ridge II Apartments Entrance (unsignalized)
25. Timberlake Road at Whitten Timberlake Chapel Entrance (unsignalized)
26. Timberlake Road at Heritage Business Center Entrance (unsignalized)
27. Timberlake Road at Misty Mountain Road (unsignalized)
28. Timberlake Road at Middleview Street (unsignalized)
29. Timberlake Road at Richland Drive/Leesville Road (signalized)

FIGURE 1 – STUDY AREA





Looking south, typical section



Looking north, roadway grade



Looking south from Leesville Road

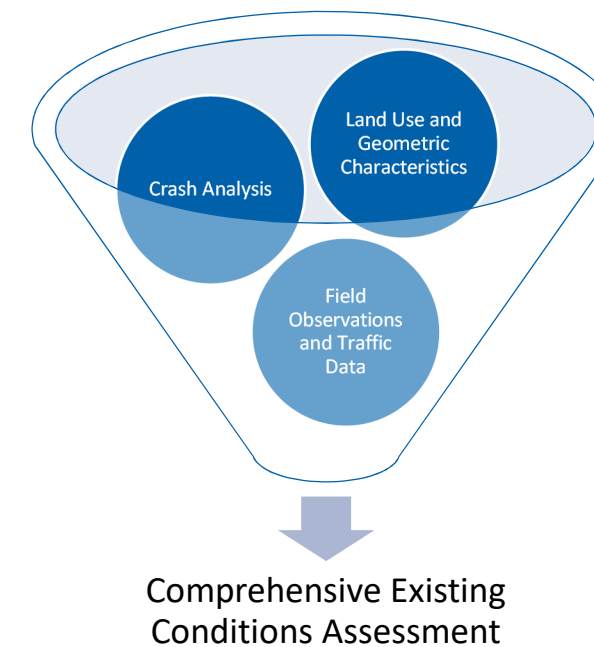


Waterlick Road intersection

Inventory and Data Collection

This corridor improvement study includes a multifaceted approach to inventory and data collection that considers land use and geometric elements, to crash and traffic data analyses. Collectively, these elements may uncover existing deficiencies in the network, and provide a baseline on which future conditions can then be established upon. **Figure 2** summarizes the inventory and data collection process.

FIGURE 2 – BASELINE CONDITIONS ASSESSMENT SUMMARY



The process begins with understanding the functionality, land use and geometric characteristics of the corridor. A crash analysis was then completed to identify crash patterns based on crash severity, roadway characteristics, and environmental characteristics. Finally, traffic data was collected, and field observations were conducted as part of the existing conditions traffic analysis. The following sections detail each approach.

General Description of Study Area

Timberlake Road is a unique transportation facility as it serves many functions and users. It is geographically situated between US 501 (Lynchburg Expressway) to the north and US 460 (Lynchburg Highway) to the south. Routes 29 and 501 are also nearby influential transportation corridors. Collectively, these corridors are critical to the City and County's economic health and quality of life. As such, Timberlake Road serves many purposes including:

- Local residential and shopping access
- School related traffic
- Local and regional truck traffic
- Employment commuting
- Pedestrian activity (although not designed for pedestrians)
- Local business access
- US-460 diversion route
- Emergency and security response

Timberlake Road (and Fort Avenue further north) serves as an important transportation spine for the City of Lynchburg and Campbell County, and it must continue to accommodate a wide array of users with varying trip purposes. Maintaining and enhancing traffic flow within the corridor is of crucial importance. Access to future development along these corridors should also be planned for and designed to ensure that it does not impede or further restrict traffic flow. In this regard, access management is very important and will be a major focus of this study.

Land Use

The Commonwealth of Virginia requires local jurisdictions to prepare and adopt a Comprehensive Plan to be reviewed at least once every five years. The County and City have each developed Comprehensive Plans that characterize land use, population trends, zoning and development patterns within their respective jurisdictions. They also include focus areas and long-term transportation projects to consider.

County Comprehensive Plan

Campbell County has developed a Land Use Plan that is a general guide for development and is intended to be used by County officials, developers and private citizens to promote logical and sustainable development. Current and future development along the Timberlake Road corridor generally falls within the following two (2) primary land use descriptions:

- Medium to high density commercial – This general land use designation is directly adjacent to the corridor. It can be characterized by a well-traveled and developed network of streets and highways with a mixture of retail, office, and industrial uses. Population centers (higher density residential) are often nearby. The most appropriate zoning pattern in this area includes all of the business and industrial zoning classifications.
- Medium to high density residential – This general land use designation begins just beyond the medium to high density commercial. These areas are generally characterized by residential uses on relatively small lots, and a well-developed network of streets and highways with direct access to major thoroughfares. Planned unit developments (PUD's) and small pockets of commercial development are also appropriate in some cases, as are parks and recreational facilities.

Campbell County's population has increased steadily over the past four decades. In 2010, the County's population was 54,842, which represented a 7.37% increase from 2000. The majority of residents live in the northern portion of the county, and the population is most dense in the Timberlake Road area. In preparation for anticipated growth and increased travel demands, a list of potential road and intersection improvements relevant to the study area have been identified in the Comprehensive Plan.

- Central Virginia Metropolitan Planning Organization (CVMPO) 2040 Long-Range Transportation Plan (RLRTP) (2010) (Unconstrained Vision Plan):
 - Rte 622 (Waterlick Rd) Bedford Co Line to Rte 1520 (Rainbow Forest) – Widen to 4 lanes
 - Rte 622 (Waterlick Rd) from US 460 Business (Timberlake Rd) to Rte 682 (Leesville Rd) – Widen to 4 lanes
- Priority Projects Central Virginia Metropolitan Planning Organization Bike Plan (2010):
 - Timberlake Rd (BYP 460 to Lynchburg Expressway): Signed share road; pave shoulder; signage; consider development of combined turn, bus, bike travel lane
 - Timberlake Rd at Waterlick Rd – turn lane and median improvements
 - Leesville Rd – widen to four lanes



Mix of land uses along Timberlake Road

City Comprehensive Plan

The City of Lynchburg has also completed a land use and population analysis as part of their Comprehensive Plan. Similar to Campbell County, the Timberlake Road corridor is flanked by community and neighborhood commercial, and low to medium density residential just beyond the commercial uses. One important note in the City is the shift in population growth. Over the first decade of the 21st century, the City began to capture a greater share of the region's growth, increasing by a percentage that exceeded every county in the region and the state as a whole – with the highest growth areas in the southern portions of City served by Timberlake Road.

The City has also developed a Plan Framework Map that highlights the City's primary commercial and mixed-use corridors. As important local and regional travel routes and commercial destinations, these areas strongly influence the City's accessibility, attractiveness, and economic vitality. For each Corridor Study Area, the Plan recommends the completion of studies to analyze existing conditions and uses; to evaluate development, redevelopment, design, and conservation alternatives; and to identify improvement strategies. Timberlake Road is included as part of this Plan; however, there are no specific improvements identified for Timberlake Road in the study area. The Plan also identifies Graves Mill as a business/technology and employment growth area.

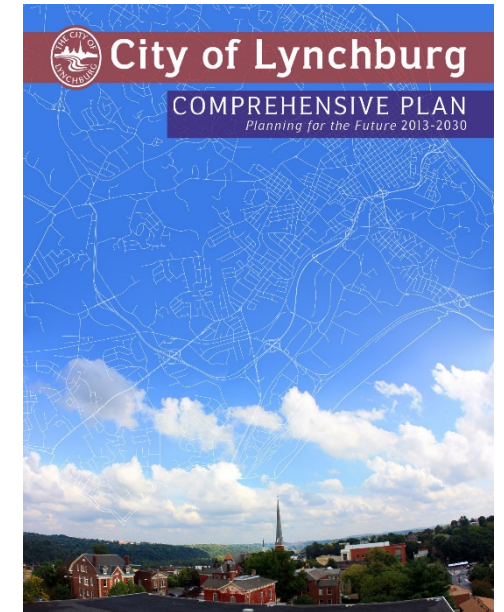
Other Relevant Plans and Studies

Relevant studies and plans that have been completed in the study area have been collected and reviewed. The following provides a summary of each:

Timberlake Road and Candlewood County Development Transportation Impact Analysis (TIA): The site for this TIA is located on the south side of Timberlake Road between the intersections of Candlewood Court and Old Graves Mill Road / Dreaming Creek Drive in the City of Lynchburg. The exact land uses and sizes are not known at this time and have been assumed for analysis purposes. As currently planned, the site will consist of residential and retail uses to be completed and occupied in year 2018. The site will be accessed by three (3) entrances on Timberlake Road and also have an interconnection to the adjacent subdivision to the south. The purpose of the study was to determine the potential traffic impacts of this development and to identify transportation improvements that may be required to accommodate the impacts of both background traffic and new development traffic. The following intersections were included in the study:

- Timberlake Road at Proposed right-in-right out access (Site Access 1)
- Timberlake Road and Candlewood Court
- Timberlake Road at Proposed southern full access (Site Access 2)
- Timberlake Road and Old Graves Mill Road/ Dreaming Creek Road

At the proposed access at Timberlake Road and Candlewood Court, it is recommended to extend the existing westbound left turn lane to 300 feet of storage, or the maximum available length. An eastbound right turn lane is also recommended. In addition, signal modification and optimization has been recommended in order to accommodate future traffic volumes. At the intersection of Timberlake Road and Old Graves Mill Road/Dreaming At



Creek Road, it is recommended to extend the existing eastbound left turn lane to the full storage length available. This will better accommodate the project queue lengths at the intersection.

Timberlake Road Development Traffic Study: The site for this TIA is located on the south side of Timberlake Road, across from the intersection of Powtan Drive. The development includes 200 apartment units that were completed and occupied in year 2017. As part of the TIA, a supplemental analysis was completed on the adjacent parcel(s) of land that directly fronts Timberlake Road. The assumed development(s) included approximately 4,800 square feet high-turnover restaurant and 4,000 square feet fast-food restaurant with drive through window to be completed in year 2020. Recommendations included:

- In 2017 build conditions, a traffic signal could potentially be warranted at the intersection of Timberlake Road and Powtan Drive under the peak hour traffic warrants, assuming only one approach lane for the new development. However, an improved design would include two approach lanes which would remove the right turns from the analysis, and therefore none of the signal warrants would then be met
- Mitigation options including adding a traffic signal and changing the intersection to allow right in/out, but left in only and no left out, can help the intersection of Timberlake Road and Powtan Drive operate with the intersection overall and all movements at LOS D or better
- If the median is reconstructed to prohibit the left turns out of the site, minor geometric improvements may be needed at the Sunny Bank intersection to accommodate the increase in U-turns. This would include relocation of a telephone pole and potential shoulder widening
- If the median is modified to prohibit the left turns, at some future point in time when additional development occurs along the frontage of Timberlake Road, a new signal warrant study should be performed to re-assess the potential need for a signal under a full access scenario

For the supplemental analysis, recommendations included:

- A traffic signal would be warranted at the intersection of Timberlake Road and Powtan Drive
- Both mitigation options (i.e. adding a traffic signal and changing the intersection to allow right in/out, but left in only and no left out) help the intersection of Timberlake Road and Powtan Drive operate with the intersection overall and all movements at LOS D or better
- Decisions on the future traffic control needs should be made whenever an actual development plan is proposed for the commercial component

Elements at Old Graves Mill Road: The site for this TIA is located along the west side of Old Graves Mill Road between Old Graves Mill Road Cut-through and Valleydale Drive. The development was assumed as a one phase build-out in 2016 that would include 252 apartment units and 18 townhome units. The development has fallen behind schedule and is still in construction.

Petition of Carriage Square Ltd.: The effort is to rezone/amend approximately 16 acres located at 240 Beverly Hills Circle to allow two hundred sixteen (216) apartment units in lieu of the previously approved one hundred ninety-two (192) apartment units and to allow the addition of lighting to walking trails in the area designated for passive recreation uses.

Geometric Characteristics

Access Management Spacing

The VDOT Road Design Manual provides Access Management Design Standards for Entrances and Intersections along roadways, which aim to provide access to land uses while preserving the flow of traffic. The access management standards are based on the functional classification of the roadway and the legal speed limit, **Table 1**. Refer to **Appendix A-1** for a graphical summary of current access management conditions along Timberlake Road.

TABLE 1 – MINIMUM SPACING STANDARDS FOR COMMERCIAL ENTRANCES, INTERSECTIONS, AND MEDIAN CROSSOVERS

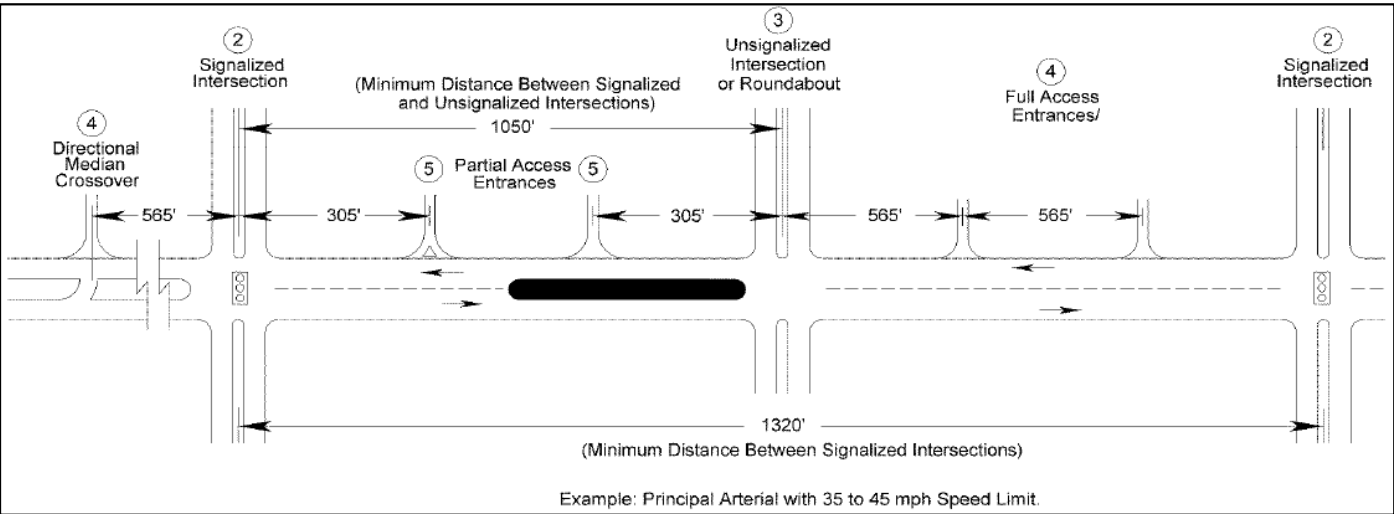
Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances & Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Principal Arterial	≤ 30 mph	1,050	880	440	250
	35 to 45 mph	1,320	1,050	565	305
	≥ 50 mph	2,640	1,320	750	495
Minor Arterial	≤ 30 mph	880	660	355	200
	35 to 45 mph	1,050	660	470	250
	≥ 50 mph	1,320	1,050	555	425
Collector	≤ 30 mph	660	440	225	200
	35 to 45 mph	660	440	335	250
	≥ 50 mph	1,050	660	445	360

SOURCE: VDOT Road Design Manual (Appendix F, Table 2-2)

Timberlake Road is classified as a principal arterial and has a legal speed limit of 45 MPH throughout the study corridor. An illustration, not to scale, of the spacing standards for a principal arterial with a speed limit in the range of 35 to 45 MPH is shown in **Table 1**. **Table 2**, **Table 3**, and **Table 4** provide the current access management spacing along Timberlake Road and lists whether or not the spacing meets the current standards. Specifically:

- **Table 2** provides the spacing between a signalized intersection and another signalized intersection
- **Table 3** provides the spacing between an unsignalized intersection/full median crossover and a signalized intersection/unsignalized intersection/full median crossover
- **Table 4** provides the spacing between a full access entrance or directional median and any intersection, full access entrance, or median crossover

FIGURE 3 – ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS



SOURCE: VDOT Road Design Manual (Appendix F, Figure 2-8.1)

TABLE 2 – SPACING BETWEEN SIGNALIZED INTERSECTION AND SIGNALIZED INTERSECTION ALONG TIMBERLAKE ROAD

Mainline	From	To	Existing Spacing	Required Spacing	Meet Standards?
Timberlake Road	Waterlick Road	Brush Tavern Drive	510'	1,320'	No
Timberlake Road	Brush Tavern Drive	Crowell Lane	1,210'	1,320'	Yes
Timberlake Road	Crowell Lane	McDonald's/Shopping Mall Entrance/Exit	535'	1,320'	No
Timberlake Road	McDonald's/Shopping Mall Entrance/Exit	Big Lots Entrance/Exit	1,735'	1,320'	Yes
Timberlake Road	Big Lots Entrance/Exit	Enterprise Drive	1,585'	1,320'	Yes
Timberlake Road	Enterprise Drive	Greenview Drive	910'	1,320'	No
Timberlake Road	Greenview Drive	Laxton Road	765'	1,320'	No
Timberlake Road	Laxton Road	Candlewood Court	2,425'	1,320'	Yes
Timberlake Road	Candlewood Court	Old Graves Mill Road/Dreaming Creek Drive	1,130'	1,320'	No
Timberlake Road	Old Graves Mill Road/Dreaming Creek Drive	Leesville Road/Richland Drive	5,990'	1,320'	Yes

TABLE 3 – SPACING BETWEEN UNSIGNALIZED INTERSECTION/FULL MEDIAN CROSSOVER AND SIGNALIZED INTERSECTION/UNIGNALIZED INTERSECTION/FULL MEDIAN CROSSOVER ALONG TIMBERLAKE ROAD

Mainline	From	To	Existing Spacing	Required Spacing	Meet Standards?
Timberlake Road	Brush Tavern Drive	Tomahawk Drive	460'	1,050'	No
Timberlake Road	Tomahawk Drive	Mountain Peak Drive	750'	1,050'	No
Timberlake Road	McDonald's/Shopping Mall Entrance/Exit	Sunny Bank Drive	630'	1,050'	No
Timberlake Road	Sunny Bank Drive	Powtan Drive	475'	1,050'	No
Timberlake Road	Powtan Drive	Big Lots Entrance/Exit	630'	1,050'	No
Timberlake Road	Big Lots Entrance/Exit	Shelor Drive	565'	1,050'	No
Timberlake Road	Shelor Drive	Beechwood Drive	310'	1,050'	No
Timberlake Road	Beechwood Drive	Enterprise Drive	710'	1,050'	No
Timberlake Road	Laxton Road	Wood Road	620'	1,050'	No
Timberlake Road	Wood Road	Putt Putt Fun Center Entrance/Exit	715'	1,050'	No
Timberlake Road	Putt Putt Fun Center Entrance/Exit	Charlie's Chicken Entrance/Exit	580'	1,050'	No
Timberlake Road	Charlie's Chicken Entrance/Exit	Candlewood Court	510'	1,050'	No
Timberlake Road	Candlewood Court	TGI Friday's Entrance/Exit	585'	1,050'	No
Timberlake Road	TGI Friday's Entrance/Exit	Old Graves Mill Road/Dreaming Creek Drive	545'	1,050'	No
Timberlake Road	Old Graves Mill Road/Dreaming Creek Drive	Timberlake Station Entrance/Exit	400'	1,050'	No
Timberlake Road	Timberlake Station Entrance/Exit	Oakmont Circle	435'	1,050'	No
Timberlake Road	Oakmont Circle	Roundelay Road	695'	1,050'	No
Timberlake Road	Roundelay Road	Timber Ridge Apartment Homes Entrance/Exit	620'	1,050'	No
Timberlake Road	Timber Ridge II Apartment Homes Entrance/Exit	Timber Ridge II Apartment Homes Entrance/Exit	595'	1,050'	No
Timberlake Road	Timber Ridge II Apartment Homes Entrance/Exit	U-Haul Moving & Storage Entrance/Exit	600'	1,050'	No
Timberlake Road	U-Haul Moving & Storage Entrance/Exit	Heritage Business Center Entrance/Exit	515'	1,050'	No
Timberlake Road	Middleview Street	Leesville Road/Richland Drive	585'	1,050'	No

TABLE 4 – SPACING BETWEEN FULL ACCESS ENTRANCE OR DIRECTIONAL MEDIAN AND ANY INTERSECTION, FULL ACCESS ENTRANCE, OR MEDIAN CROSSOVER ALONG TIMBERLAKE ROAD

Mainline	From	To	Existing Spacing	Required Spacing	Meet Standards?
Timberlake Road	Heritage Business Center Entrance/Exit	Misty Mountain Road	575'	565'	Yes
Timberlake Road	Misty Mountain Road	Middleview Street	970'	565'	Yes

Crash Analysis

A safety analysis was performed on the Timberlake Road study corridor using crash data from the VDOT Roadway Network System (RNS). The crash data covered the period from January 1, 2011 to December 31, 2015 and was used to identify crash patterns based on crash severity, roadway characteristics, and environmental characteristics. The safety issues in the corridor are magnified by the number of median crossovers and the grade separation between the eastbound and westbound lanes. The following sections provide a summary of the crashes that occurred within the Timberlake Road study corridor during the five-year crash analysis period.

Summary of Overall Study Area Crashes

661 total crashes were reported within the study area over the five-year crash analysis period. Of the reported crashes, there were 5 fatalities, 200 crashes involving bodily injury, and 456 crashes that resulted in property damage only (PDO). A yearly summary of the crashes, by crash severity, is shown in Table 5 and a full summary is provided in Appendix A-2.

TABLE 5 – YEARLY CRASH SUMMARY BY CRASH SEVERITY

Year	Number of Crashes			
	Fatal	Injury	PDO	Total
2011	0	52	77	129
2012	4	38	88	130
2013	0	36	98	134
2014	0	38	100	138
2015	1	36	93	130
Total	5	200	456	661

The corridor crashes were split directionally with 320 (48%) eastbound reported crashes and 341 (52%) westbound reported crashes. Approximately 90 % of the corridor crashes occurred during clear weather conditions. There were 148 (22%) crashes throughout the Timberlake corridor that involved speeding. Additionally, 31 (5%) of crashes were alcohol related.

Figure 4 below provides a hotspot map of all injury and fatal crashes depicting locations of the most severe crashes along the Timberlake Road corridor. The data was analyzed directionally, and the hotspots for both directions are shown in the one graphic. The hotspots of severe crashes occur at the intersections of Jordan Drive, Enterprise

Drive/Oakdale Circle, Greenview Drive, and Laxton Road. The most prevalent collision types at these locations were angle (46%) and rear end crashes (40%).

There were minimal pedestrians observed during field observations, but there were “PED CROSSING” signs located at Laxton Road and between Candlewood Court and Wood Road. Pedestrian facilities are not available at either location. A total of five pedestrian crashes occurred in the corridor with one being a fatal crash. Two of the five crashes occurred at intersection. The pedestrian related crashes are shown in Figure 5.

FIGURE 4 – TIMBERLAKE ROAD FATAL AND INJURY CRASH HOTSPOTS



FIGURE 5 – TIMBERLAKE ROAD PEDESTRIAN CRASHES



The crashes were categorized into eastbound and westbound directions to understand the crash characteristics in each direction of travel. There were 320 reported eastbound crashes and 341 reported westbound crashes over the five-year crash analysis period.

Eastbound Timberlake Road Crash Summary

Of the 320 reported crashes in the eastbound direction, there were 3 fatal crashes, 93 crashes involving bodily injury, and 224 were PDO crashes. The 3 fatal crashes were categorized as angle crashes occurring during clear and dry conditions.

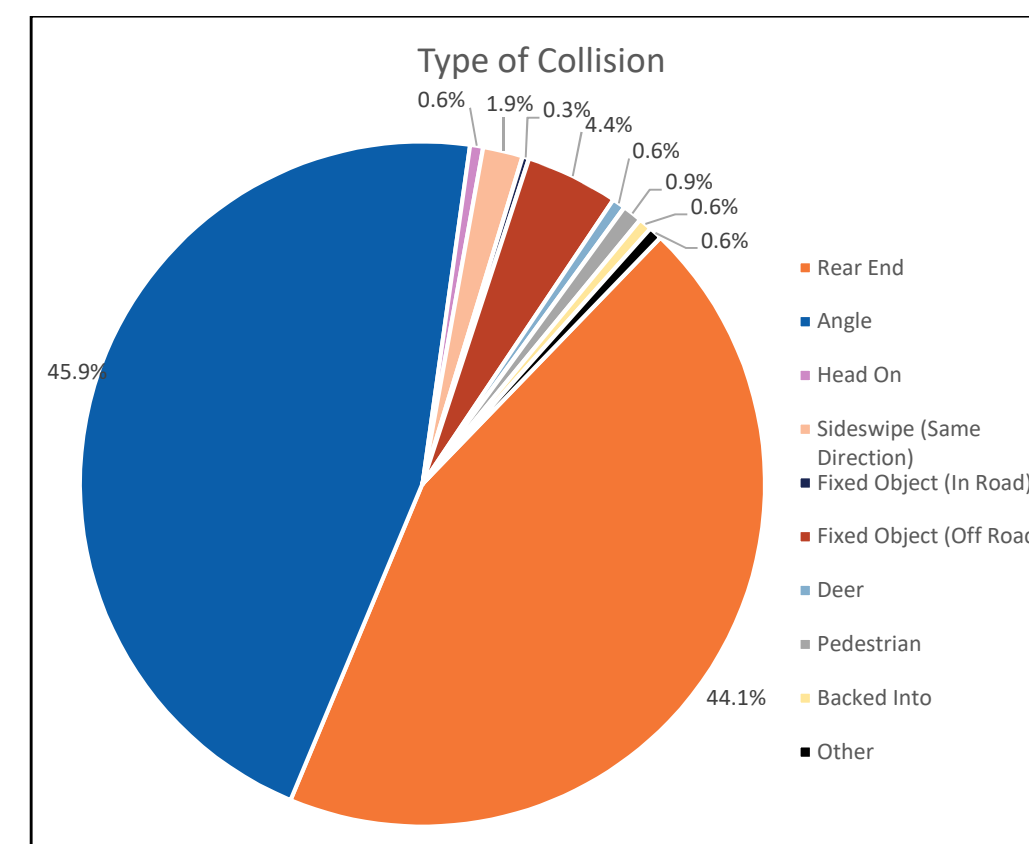
The first fatal corridor crash occurred Tuesday May 22, 2012 at the signalized intersection at Enterprise Drive/Oakdale Circle. The is northbound approach Oakdale Circle (western circle connection), is offset approximately 40 feet from the southbound approach Enterprise Drive. Additionally, the eastern circle connection ties in at Timberlake Road approximately 60 feet before the signalized intersection. A motorcycle was heading eastbound traveling at excessive speeds, and struck another vehicle completing a turn onto Enterprise Drive. The driver of the motorcycle was killed. The signal allowed for permissive lefts on Timberlake, and in 2013 flashing yellow arrow (FYA) signals along the Campbell County side of the study corridor. During the field review it was observed that dual indicated “WATCH FOR MOTORCYCLES” signs were in place 500 feet before the intersection in the westbound direction.

Two of the fatal crashes occurred at the intersection of Timberlake Road and Powtan Drive, which is an unsignalized three leg approach along Timberlake Road at milepost 2.60. There is a significant grade change between the eastbound and westbound directions at this location with the western direction (Powtan Drive side) located at a higher elevation than the eastern direction. There is a sign “NO DOUBLE STACKING IN CROSSOVER” presumably due to sight distance limitations within the crossover. The first crash at Powtan Drive occurred Monday September 24, 2012 involved a vehicle traveling eastbound completing a left turn onto Powtan Drive, and a moped traveling westbound struck the turning vehicle. The moped driver was ejected and a third vehicle hit the moped driver, and the third vehicle struck the moped driver. Alcohol was determined to be involved with the moped driver, but not the turning vehicle. The crash occurred at 7:46 PM in darkness but the intersection was noted as being lighted. The second crash at Powtan Drive occurred Saturday May 23, 2015 involved a vehicle turning without right-of-way from Powtan Drive onto westbound Timberlake striking a motorcycle in the travel lane. The driver of the motorcycle was killed. The crash occurred at 11:20 AM in clear conditions. Alcohol, speeding, or other distractions were not factors of the crash.

Figure 6 provides a breakdown of the crashes by collision type. The two most common types of collisions were angle crashes (46%) and rear-end crashes (44%). It was also found that:

- 78% of the reported crashes occurred during the week
- 42% of the reported crashes occurred in PM peak period (3:00 PM to 7:00 PM) and 8% occur during the AM peak period (6:00 AM to 10:00 AM)
- 24% of the reported crashes occurred in dark conditions
- 90% of the reported crashes occurred in clear weather conditions

FIGURE 6 – EASTBOUND TIMBERLAKE ROAD CRASH TYPE SUMMARY



Westbound Timberlake Road Crash Summary

Of the 341 reported crashes in the southbound direction, there were 2 fatal crashes, 107 crashes involving bodily injury, and the remaining 232 were PDO crashes.

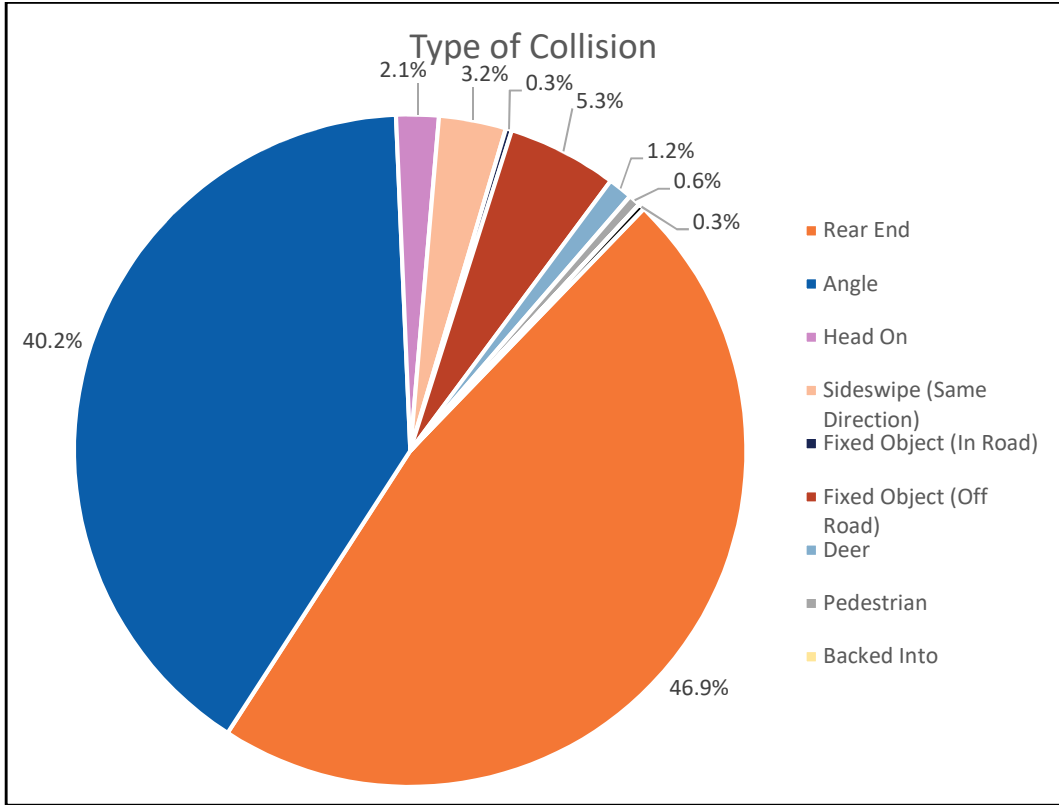
The first fatal crash occurred Saturday April 21, 2012 at the unsignalized intersection at Misty Mountain Road/Citgo Gas Station. There is a forced turn island in the median separating the two directions of travel along Timberlake, and prohibiting left turns onto Timberlake Road from the side streets. There is a noticeable grade separation between the eastbound and westbound directions. The crash occurred at 2:13 AM on a Saturday under clear weather conditions. The first vehicle was speeding in the westbound travel lane of Timberlake Road and struck a vehicle turning onto Misty Mountain Road. Additionally, the driver of the first vehicle was under the influence of drugs and alcohol. The driver of the second vehicle was killed in the crash.

The second fatal crash occurred Friday August 3, 2012 along Timberlake Road between Wood Road and Candlewood Court at a median crossover giving access to a Dairy Queen and Knollwood Townhomes. A pedestrian was hit while crossing Timberlake Road at the crossover. The crash occurred in daylight at 2:02 PM with no improper action recorded for the driver of the vehicle. During field review it was noted that dual indicated “PED CROSSING” signs were in place 500 feet before the median opening in both directions of travel. There are no pedestrian accommodations despite the signing.

Figure 7 provides a breakdown of the crashes by collision type. The two most common types of collisions were rear end crashes (47%) and angle crashes (40%). Specific locations are referenced in Figure 8 and Figure 9. It was also found that:

- 76% of the reported crashes occurred during the week
- 39% of the reported crashes occurred in PM peak period (3:00 PM to 7:00 PM) and 12% occurred during the AM peak period (6:00 AM to 10:00 AM)
- 20% of the reported crashes occurred in dark conditions
- 89% of the reported crashes occurred in clear weather conditions

FIGURE 7 – WESTBOUND TIMBERLAKE ROAD CRASH TYPE SUMMARY



Crash Histograms

The roadway was divided into 13 quarter-mile segments (spanning mileposts 1.75 to 5.00) and one segment of 0.15 miles (milepost 5.00 to 5.15) to better understand where the crashes were occurring. Figure 8 and Figure 9 show the crashes by collision type and travel direction. Five segments experienced more than 50 crashes over the five-year crash analysis period. The segments are:

- MP 1.75 to MP 2.00 at Waterlick Road: 54 total crashes (27 eastbound and 27 westbound)
- MP 2.25 to MP 2.50 at Brush Tavern Drive: 74 total crashes (34 eastbound and 40 westbound)
- MP 3.00 to MP 3.25 at Enterprise Drive and Greenview Drive: 97 total crashes (32 eastbound and 65 westbound)
- MP 3.25 to MP 3.50 at Laxton Road: 114 total crashes (76 eastbound and 38 westbound)
- MP 3.75 to MP 4.00 at Candlewood Court and Old Graves Mill Rd: 53 total crashes (31 eastbound and 22 westbound)

FIGURE 8 – TIMBERLAKE ROAD CRASH HISTOGRAMS (CRASH TYPE) FROM MP 1.75 TO MP 3.50

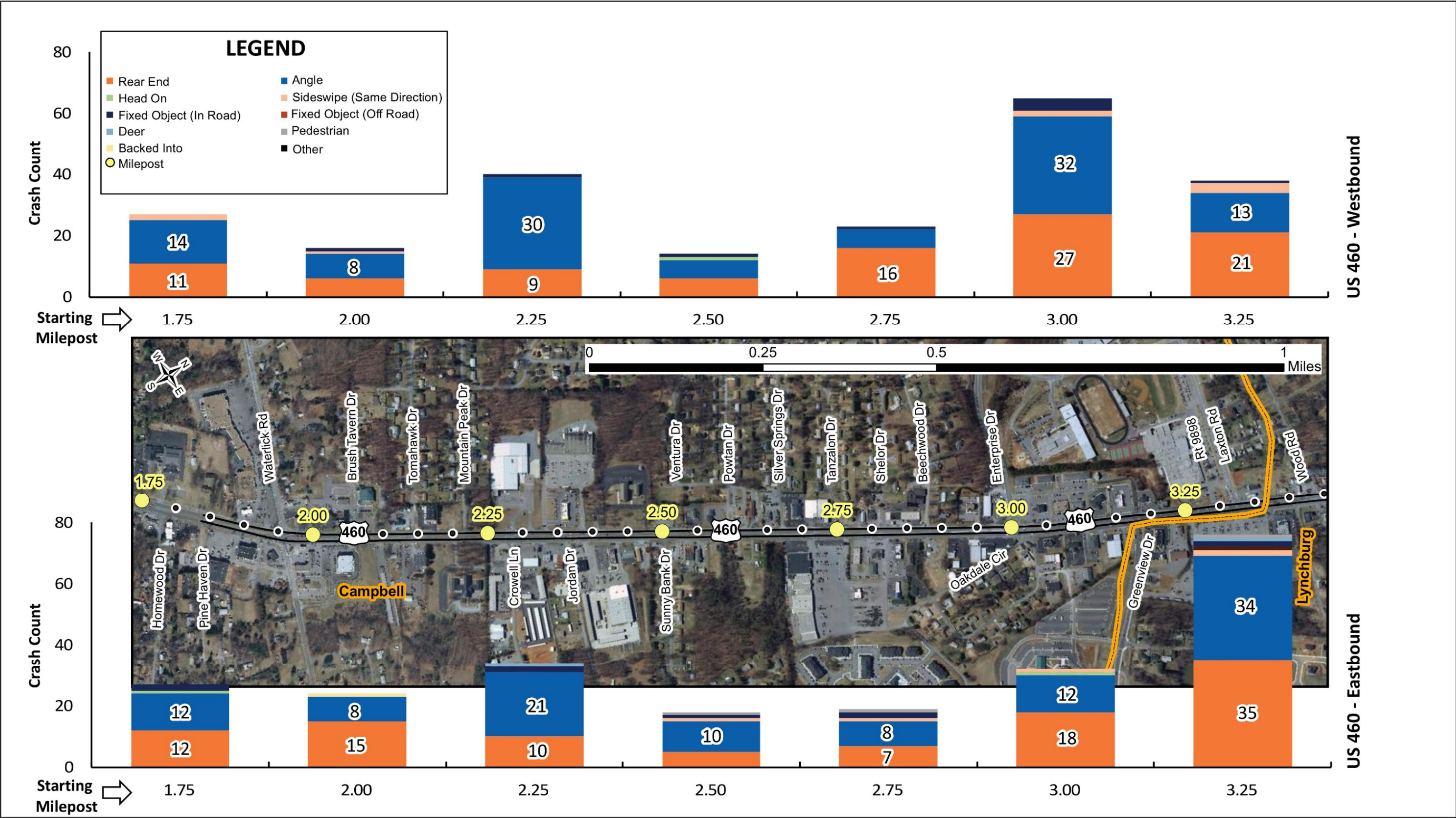
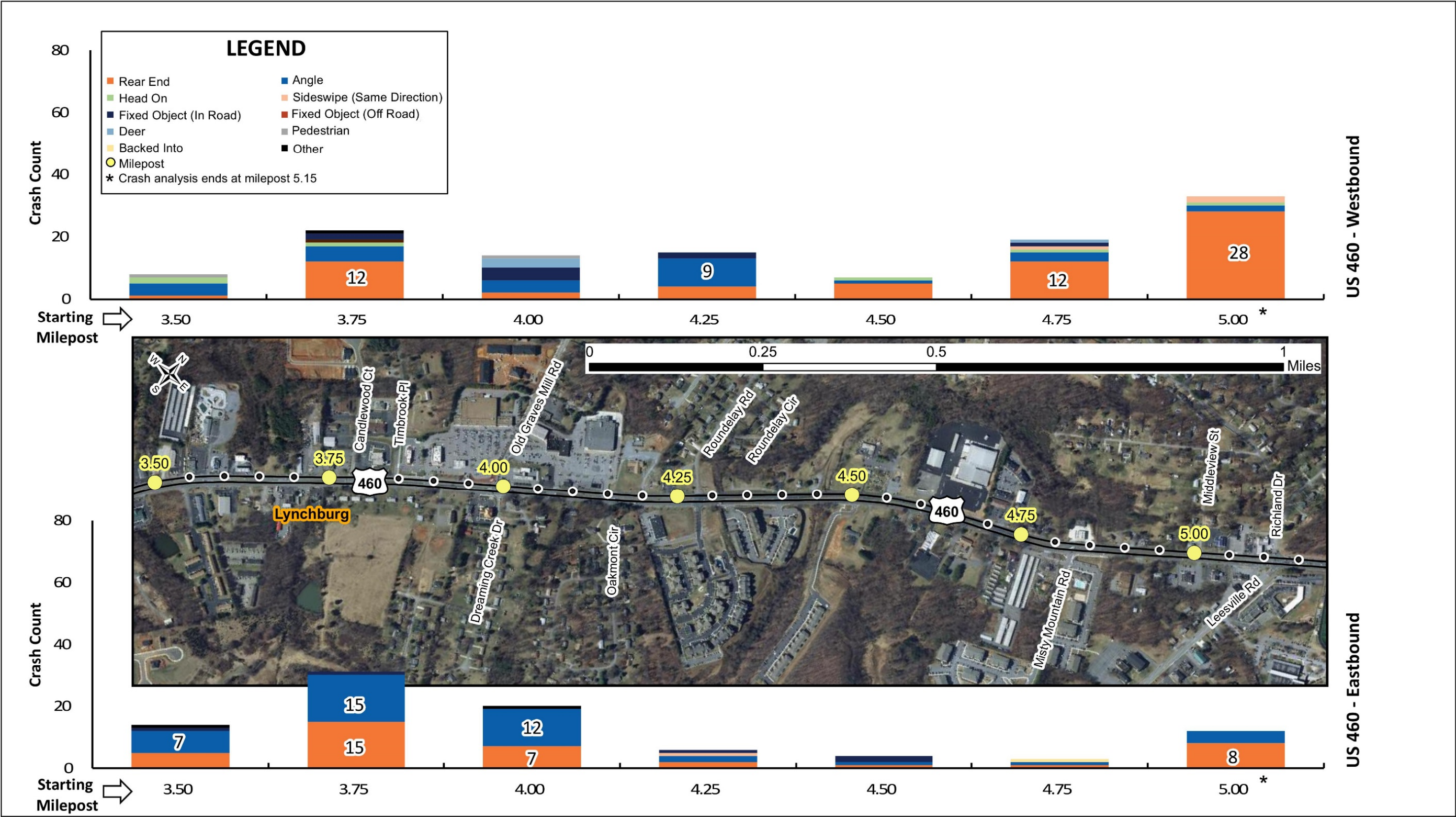


FIGURE 9 – TIMBERLAKE ROAD CRASH HISTOGRAMS (CRASH TYPE) FROM MP 3.50 TO MP 5.15



Traffic Data

Traffic data was collected and detailed field observations were conducted as part of the existing conditions traffic analysis. Intersection turning movement counts (TMCs) at each study area intersection were collected on September 20 – 22, and November 16, 2016 on clear days while local schools were in session. TMCs were collected during the AM peak period from 7:00 – 9:00 AM, and during the PM peak period from 4:00 – 6:00 PM. A continual volume and vehicle classification count over a 48-hour period was also collected by lane and direction. **Figure 1** illustrated the locations of each intersection TMC and location of the 48-hour count. **Figure 12** illustrates the AM and PM peak hour TMCs for Timberlake Road. **Figure 13** illustrates the existing lane geometries for Timberlake Road. All traffic counts are provided in **Appendix A-3 and A-4**.

Field Review Observations

A field review of the study area was conducted to inventory and confirm geometric conditions and observe traffic operations issues in the corridor. Congested locations and safety issues created by traffic queuing, access management and signal operations were also observed. The following summarizes the general conditions observed along the corridor:

- Waterlick Road utilizes split phasing (northbound and southbound); extensive queuing occurred on all approaches. Queues consistently did not clear every intersection cycle. This was observed on the Waterlick northbound approach. Queues extended back over 20 vehicles.
- Close proximity of uncoordinated traffic signals on the west end of the corridor (Waterlick Road to Laxton Drive) exacerbates stop-n-go conditions.
- Lengthy queuing was consistently observed on the northbound approach on Greenview Drive – mainly for the shared through/left movement.
- Timberlake Road between Greenview Drive and Laxton Road is the most congested section in the corridor. The two intersections are approximately 750' apart with two key access points in between – Lowes to the east and Brookville High School to the west. The close interaction results in extensive queuing that spilled back to the adjacent intersection, blocking turn pockets.
- Queuing on the eastbound left from Timberlake Road to Laxton Road consistently extended beyond the storage bay, even during non-peak times; however, it typically cleared in one cycle (To note, there may have been vehicles unable to enter the turn pocket due to queuing on Timberlake Road).
- The traffic signal at Old Graves Mill Road is newly rebuilt. Queuing on the Old Graves Mill Road approach is long and unable to clear in one cycle, at times. Two new residential developments are pending on the north end of Old Graves Mill Road at Nationwide Drive and further to the north near Graves Mill Road.



Queuing on Waterlick Road



Queuing approaching Laxton Road



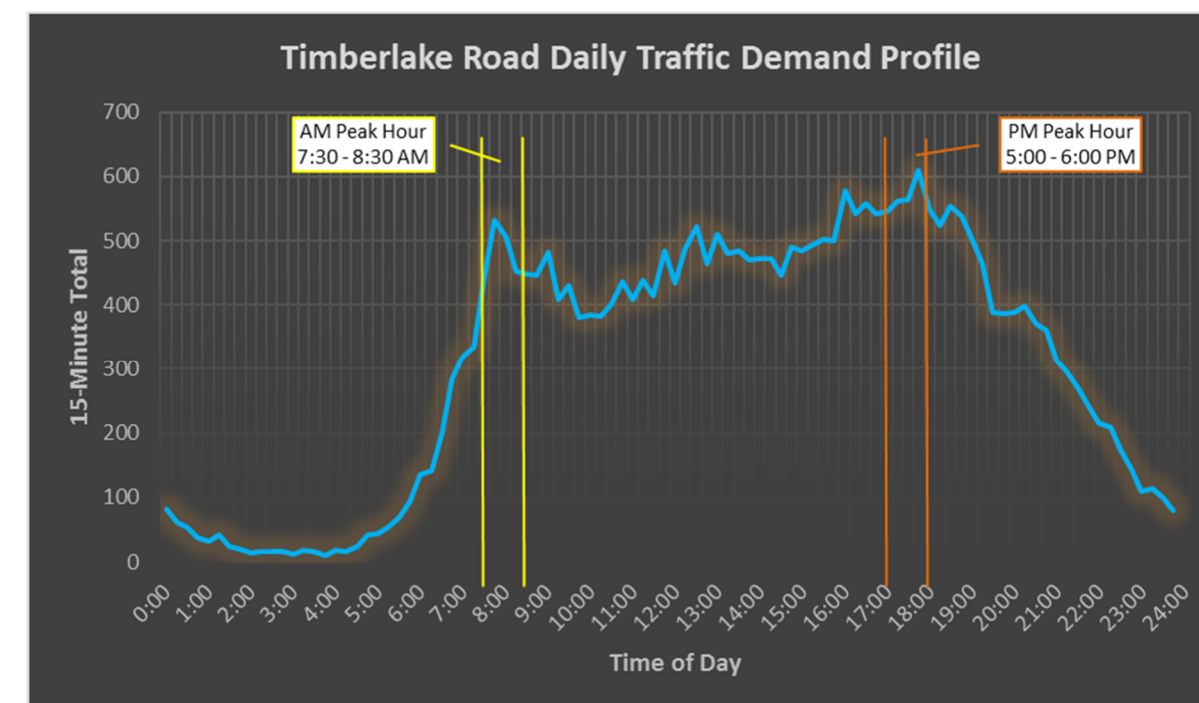
Northbound left to Laxton Road

- Consistent truck traffic was observed making eastbound lefts on to Old Graves Mill Road. Upon further investigation, many of the trucks were traveling to the Lynchburg Center of Industry, off Graves Mill Road. To note, one semi-truck spans over 25 percent of the storage length for the turn lane.
- The Leesville Road intersection experiences extensive queuing and delays on all approaches in the peak periods. Eastbound queues approaching Leesville Road were typically over 15 vehicles, while westbound left queuing consistently extended beyond the storage length of the turn lane. Furthermore, Leesville Road movements are split phased.
- Lack in available gaps in traffic on Timberlake Road limits the ability to make left-turns from stop-controlled intersections. At times, this leads to drivers making an initial right-turn, then a u-turn.
- Grade and uneven pavement is common throughout the corridor. The intersections of Crowell Lane, Big Lots, and Laxton Road exhibit uneven pavement conditions between the bifurcated northbound and southbound lanes. The uneven conditions will impact northbound and southbound through movements; however, the volumes are low enough to have no impact on operations (less than one vehicle per cycle). The uneven conditions did not appear to impact the turning movements from an operational perspective. There are several median access points where grade and uneven pavement could restrict sight distance.
- A noticeable increase in traffic demand occurred around 3:00 PM, then traffic demand slightly reduced until 5:00 PM, when demand peaked for the day. This mid-afternoon increase can be attributed to local school traffic. The fluctuation in traffic was most apparent between Greenview Drive and Laxton Road.

Daily Traffic Demand

Timberlake Road is part of a larger network of roads in the region. Conditions on US-460 and US-501 are inextricably linked to conditions along Timberlake Road. For example, an incident on US-460, whether due to highway maintenance or a traffic accident, may lead to increased traffic on Timberlake Road. To help understand the existing operational characteristics of the corridor, it's important to understand daily traffic trends. The 48-hour count (averaged for one day) obtained between Greenview Drive and Laxton Road provides a weekday profile of traffic demand along Timberlake Road, illustrated in **Figure 10**.

FIGURE 10 – DAILY TRAFFIC PROFILE



Typically, two pronounced spikes occur during the day, corresponding to the AM and PM peaks, while traffic levels are generally lower during the mid-day hours. On Timberlake Road, traffic levels increase sharply between 6:00 and 8:00 AM; however, only slightly decrease over the next several hours. Approaching noon, traffic levels then begin to steadily increase throughout the day before peaking around 5:30 PM. Elevated traffic levels throughout the day is indicative of local school and commercial business activity. The peak hours suggested by the daily count are 7:30 – 8:30 AM, and 5:00 – 6:00 PM. Timberlake Road serves approximately 30,000 vehicles per day.

Peak Hour Determination

A common peak hour was determined that best reflects global traffic conditions along the corridor. All AM and PM TMCs were totaled by 15-minute and one-hour increments. **Table 6** illustrates the results of the process.

TABLE 6 – PEAK HOUR DETERMINATION

AM Peak Hour			PM Peak Hour		
Time	15-Minute Totals	Hourly Totals	Time	15-Minute Totals	Hourly Totals
07:00 AM	9,564		04:00 PM	16,896	
07:15 AM	12,917		04:15 PM	17,218	
07:30 AM	16,864		04:30 PM	16,845	
07:45 AM	17,118	56,463	04:45 PM	16,457	67,416
08:00 AM	13,569	60,468	05:00 PM	18,350	68,870
08:15 AM	14,113	61,664	05:15 PM	18,883	70,535
08:30 AM	14,040	58,840	05:30 PM	18,130	71,820
08:45 AM	13,952	55,674	05:45 PM	18,029	73,392
Peak Hour: 7:30 – 8:30 AM			Peak Hour: 5:00 – 6:00 PM		

The AM and PM peak hours determined through this process match the AM and PM peak hours derived from the 48-hour volume count obtained on Timberlake Road over the same general time period; therefore, the common peak hours used for the purposes of this study were 7:30 – 8:30 AM, and 5:00 – 6:00 PM. In fact, all intersections during the morning experience the same peak hour, with only several locations off by 15 minutes during the PM peak hour.

Heavy Vehicle Percentages

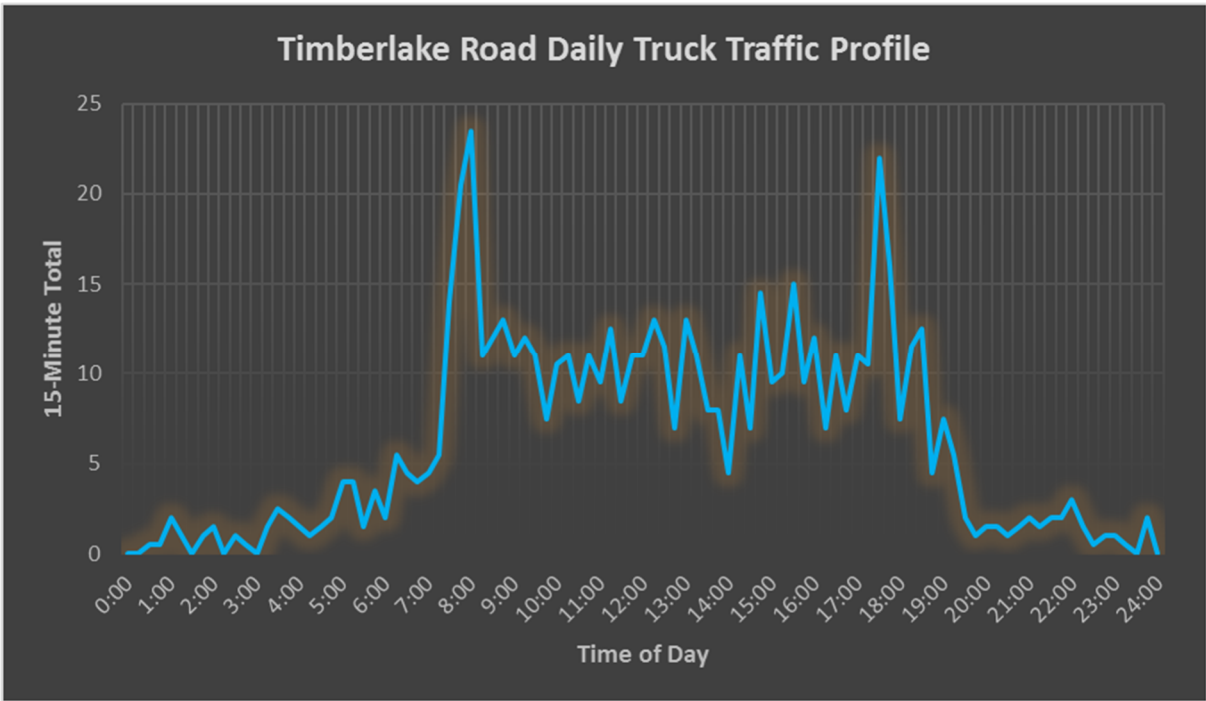
Heavy vehicle counts were collected at each study intersection as part of the data collection process. Heavy vehicle percentages were calculated for each movement at all study area intersections during the common study area AM and PM peak hours. In general, truck percentages on Timberlake Road ranged from one to three percent. However, individual turning movements experience higher truck percentages at several locations in the corridor due to lower total volume. For comparison, vehicle classification data collected as part of the 48-hour volume count is summarized in **Table 7**.

TABLE 7 – VEHICLE CLASSIFICATIONS

Vehicle Compositions by Class				
Measure	Class I	Class II	Class III	Class IV+
Daily Volume	193	24,911	4,308	613
Daily Percent	0.6%	83.0%	14.3%	2.0%

In general, Class I and II compositions include motorcycles, standard size cars and small pick-up trucks. Class III vehicles are typically two-axle larger pick-up trucks, vans and delivery vehicles. Class IV and greater refers to buses and semi-trucks that have two, three or more axles. Heavy vehicle percent, Class IV and greater, along Timberlake is approximately 2.0% of total volume. This data reflects what was captured at the intersection level for through traffic on Timberlake Road. **Figure 11** illustrates the weekday profile of truck demand.

FIGURE 11 – DAILY TRUCK TRAFFIC



Two pronounced spikes can be seen at approximately 8:00 AM and 5:30 PM. These spikes fall within the common peak hours determined for the corridor. It’s important to recognize that a typical loaded truck can weigh over 80,000 pounds and is over 70’ in length. The average queued car is 25’; therefore, truck activity along the corridor can have a significant impact on queuing, particularly for turning movements.

Seasonal Adjustment Factors

Seasonal fluctuation in traffic is negligible in the study area; therefore, adjustment factors were not applied. Typically, adjustment factors are applied to locations that serve heavy tourist destinations, coastal regions, special events such as government sessions, etc.

Traffic Volume Balancing

The Timberlake Road corridor contains many access points, parking lots and garages located between the study area intersections; therefore, some discontinuity in traffic volumes is expected. To avoid manual adjustments that could potentially over or under-inflate traffic levels, volumes were not balanced for the purposes of this analysis. To note, the peak hours were very consistent along the corridor with only minor fluctuations observed between intersections.

Speed Data

Video along the corridor was obtained during the peak hours to demonstrate an average speed based on the average travel time of vehicles to traverse Timberlake Road. In-field observations were made during the collection of calibration data to note unique operating conditions to aid in the calibration process, if necessary. The posted speed limit along the corridor is 45 miles per hour (mph).

FIGURE 12 A – EXISTING (2016) TURNING MOVEMENT COUNTS

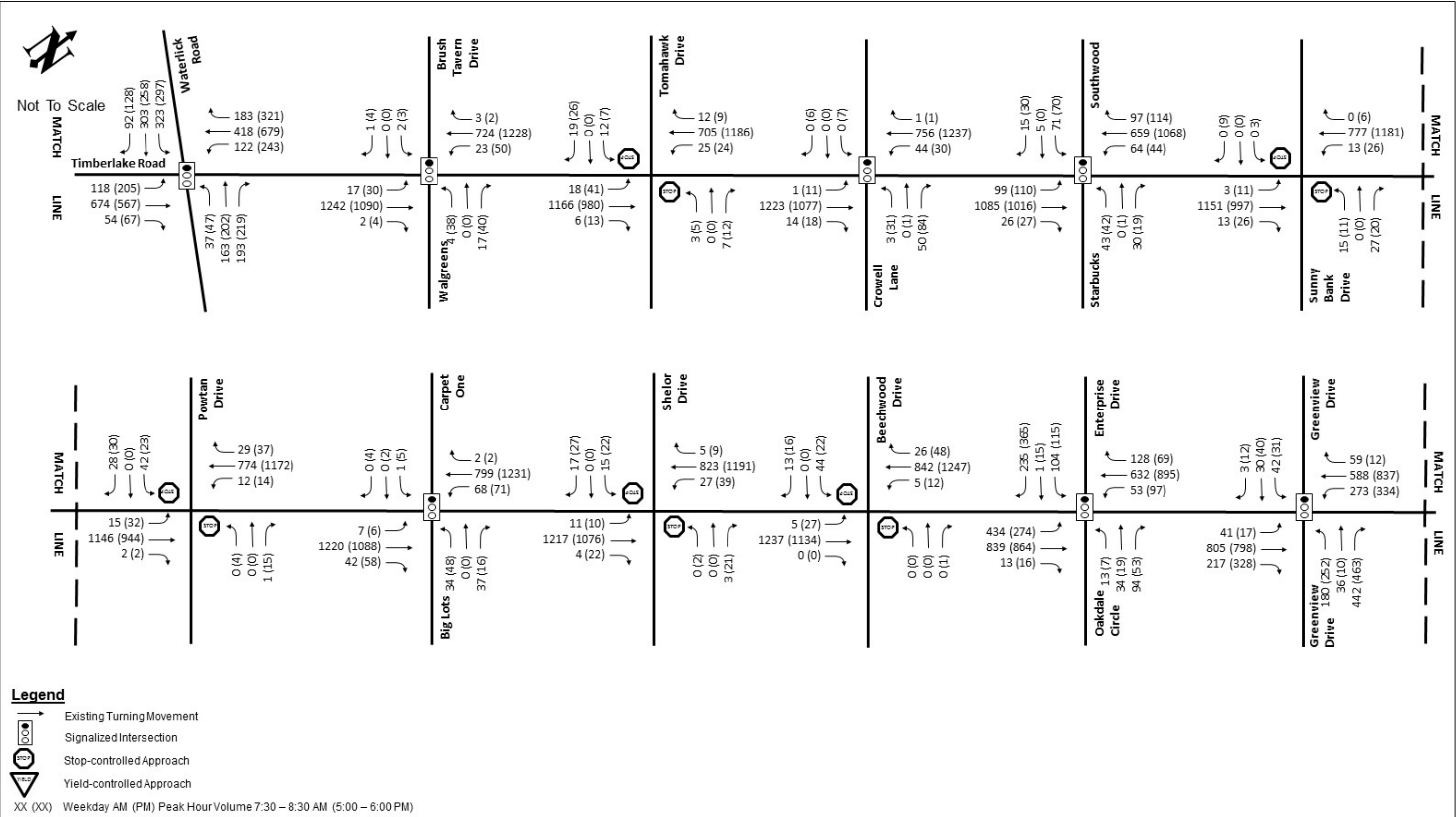


FIGURE 12 B – EXISTING (2016) TURNING MOVEMENT COUNTS

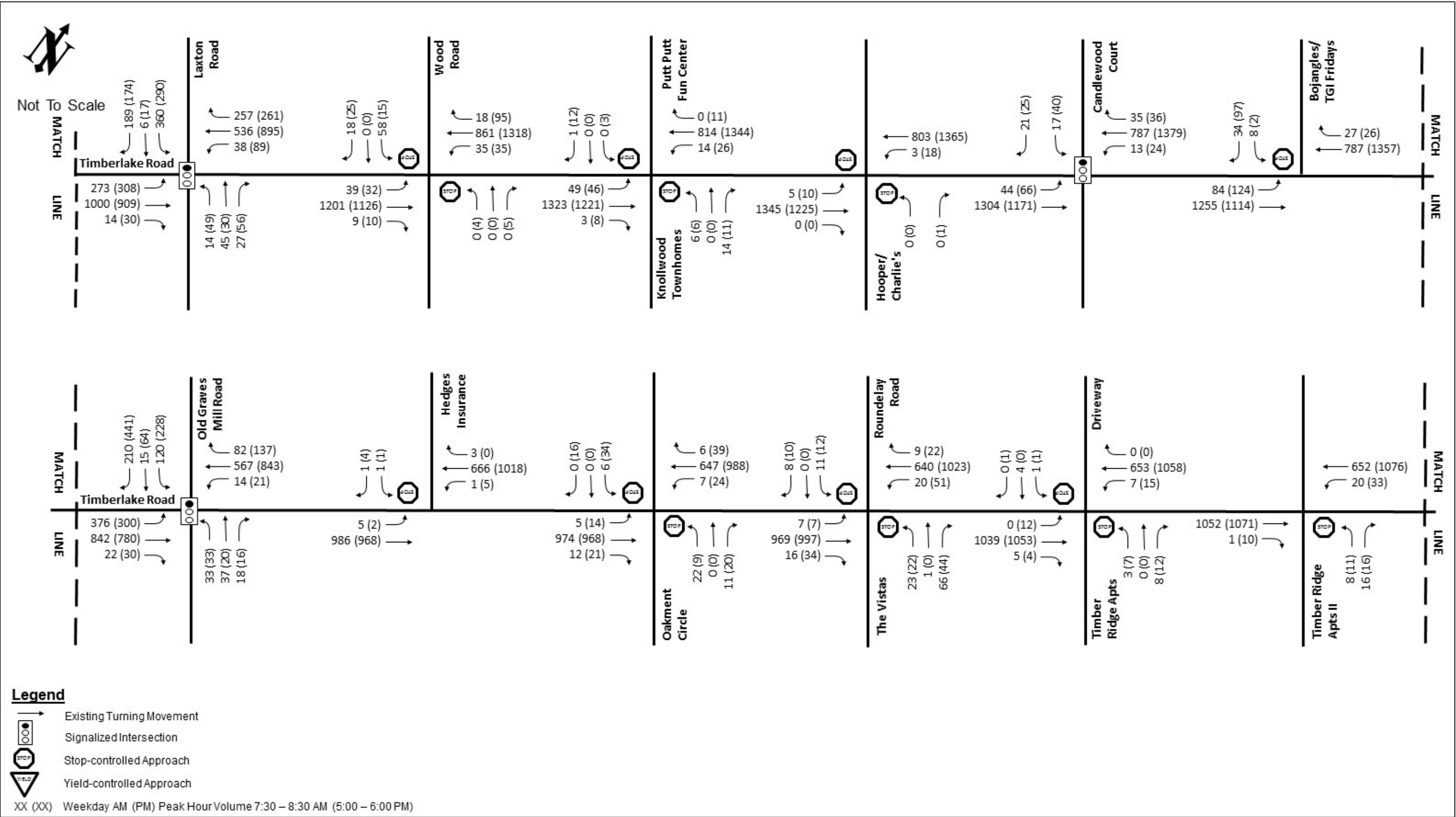


FIGURE 12 C – EXISTING (2016) TURNING MOVEMENT COUNTS

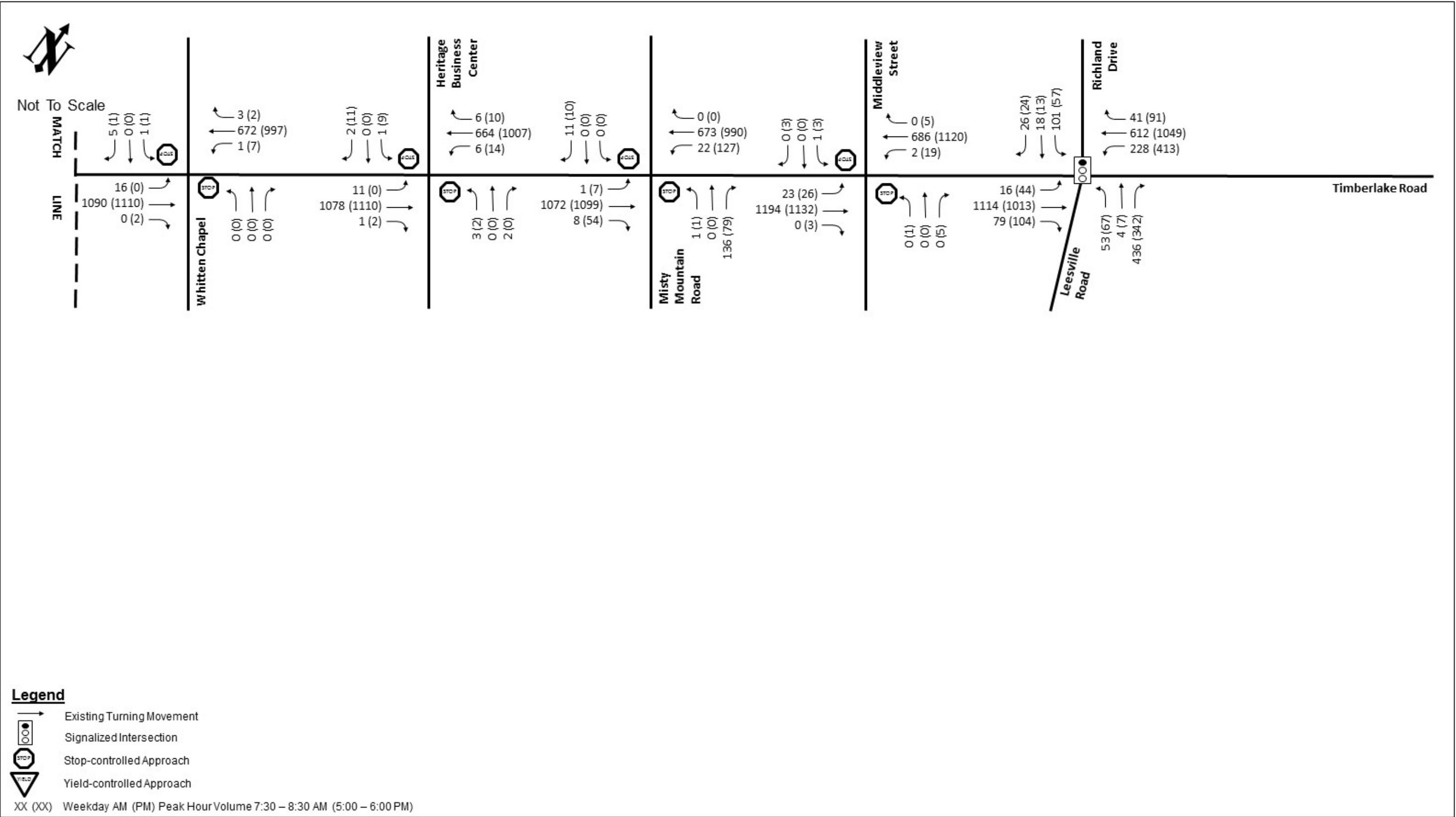


FIGURE 13 A – EXISTING TIMBERLAKE ROAD LANE CONFIGURATIONS

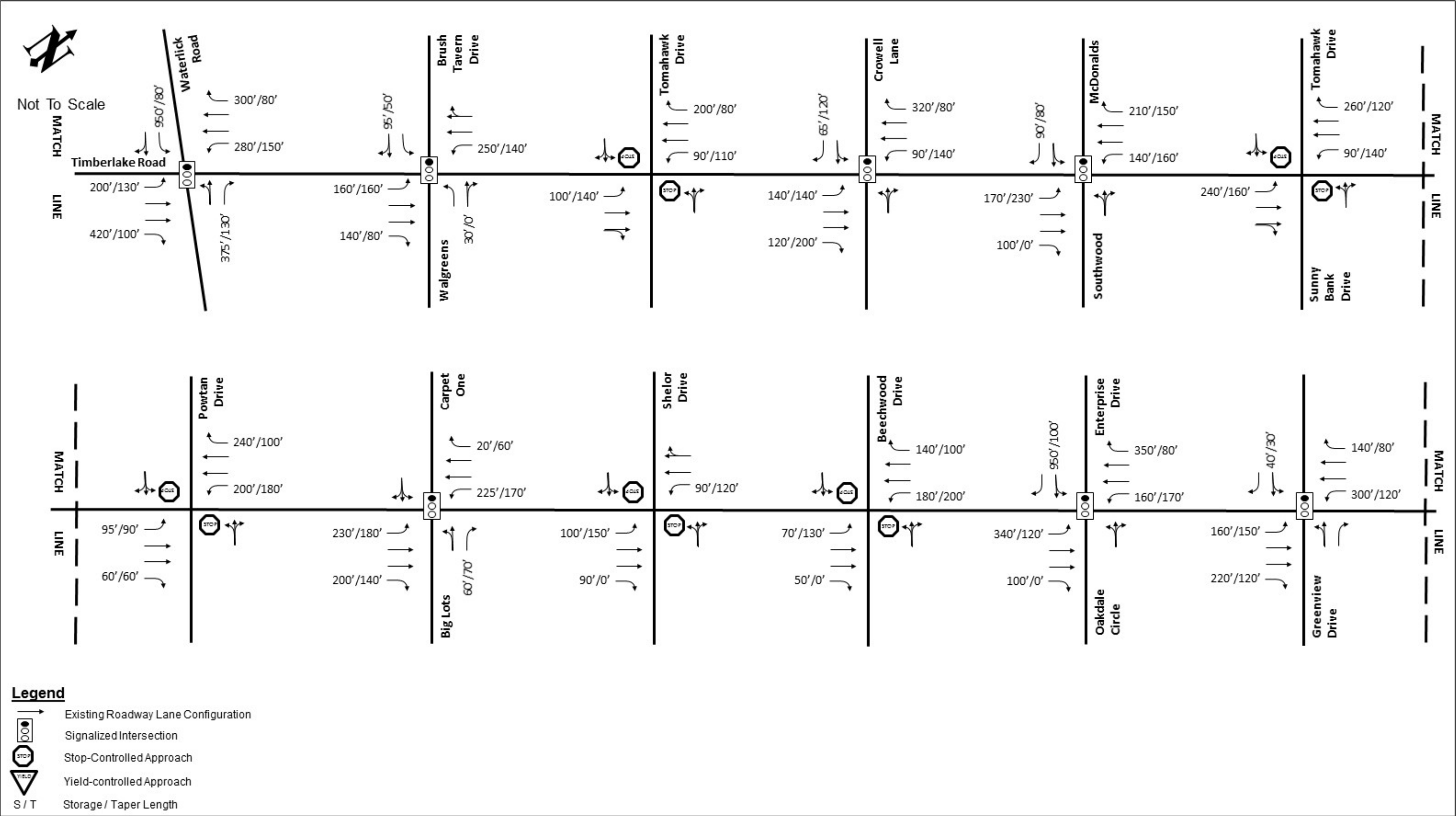


FIGURE 13 B – EXISTING TIMBERLAKE ROAD LANE CONFIGURATIONS

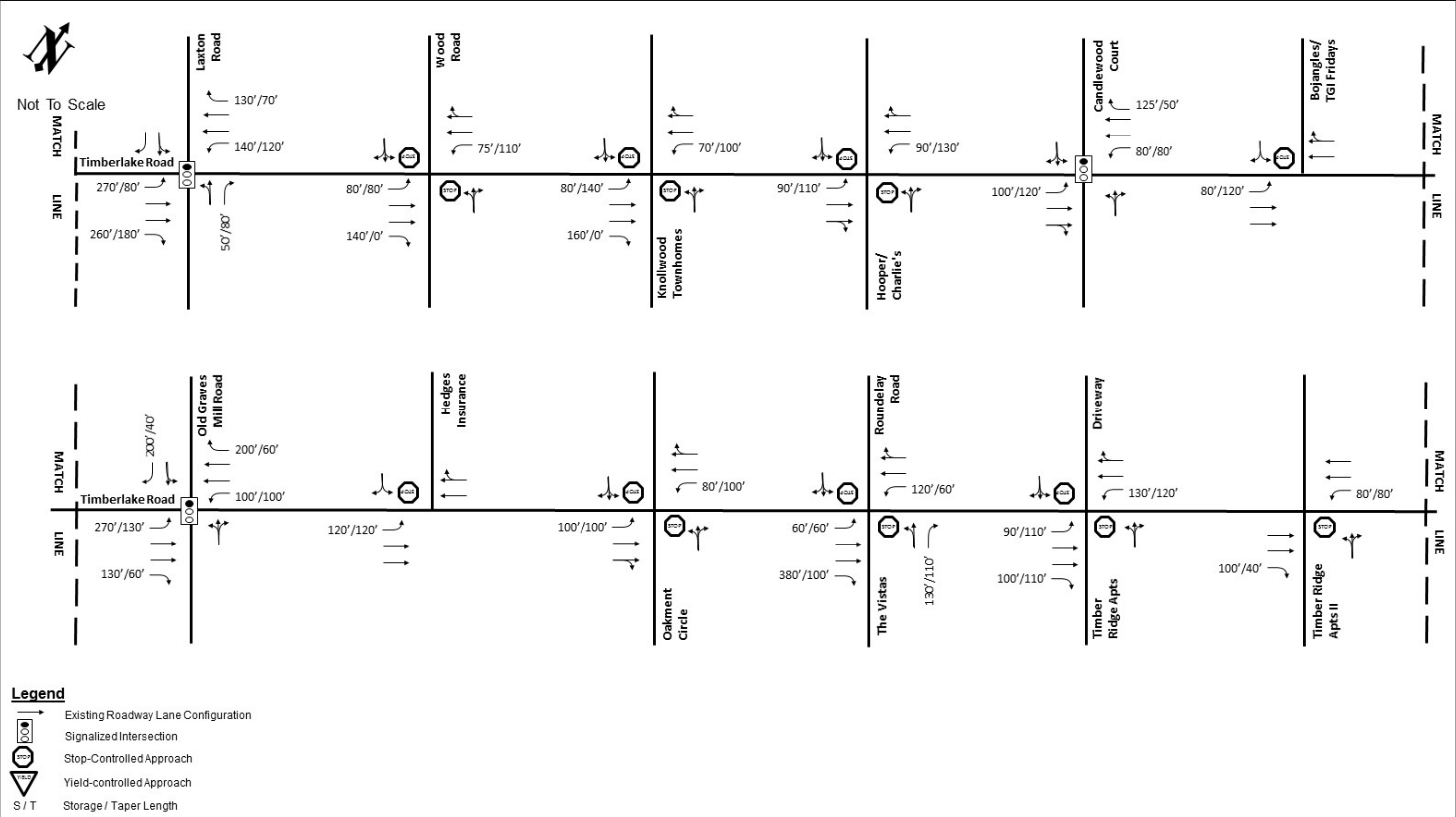
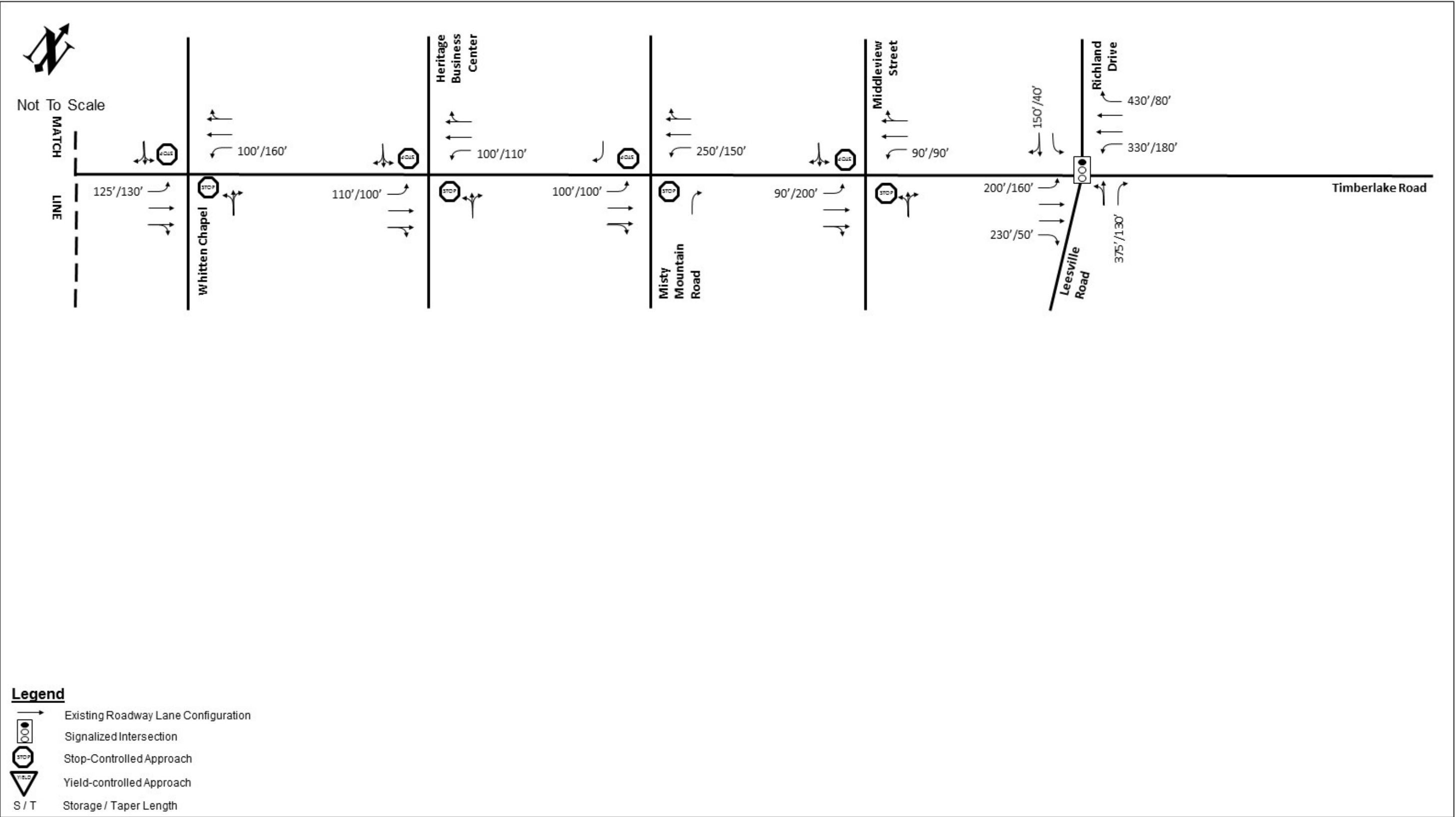


FIGURE 13 C – EXISTING TIMBERLAKE ROAD LANE CONFIGURATIONS



Existing Conditions

Traffic Analysis Assumptions

The traffic analysis for the study intersections was completed using Synchro 9.0, a computer-based intersection operations model, which implements procedures presented in the Transportation Research Board’s (TRB) *Highway Capacity Manual* (HCM) 2010. Synchro is designed to evaluate the performance of arterials, signalized intersections, and unsignalized intersections (two-way stop, all-way stop, and roundabouts). The intersection level of service (LOS) reported by Synchro reflects the total intersection delay, and delay for movements. Traffic simulations using SimTraffic were conducted to reflect queuing conditions along the corridor.

Synchro inputs and analysis methodologies were consistent with the VDOT Traffic Operations and Safety Analysis Manual (TOSAM), Version 1.0. The signal timing and phasing plans for all signalized intersections were provided by the City of Lynchburg and VDOT. A detailed summary of the Synchro analysis inputs and assumptions is provided in **Appendix B-1**.

Traffic Analysis Results

The existing conditions traffic analysis results are summarized in the following section. Two measures of effectiveness were selected to measure the quantitative performance of the study area intersections:

- Average vehicle delay by movement, approach, and intersection – measured in seconds per vehicle
- Maximum queue length – measured in feet

Delay and Level of Service

An intersection LOS is a qualitative measure of vehicular delay and considers several conditions related to intersection design and traffic volume, and the perception of those conditions by motorists. Ratings range from A to F, with LOS A indicating little or no average delay and LOS F indicating severe average delays, unstable traffic flow, and stop-and-go conditions. **Table 8** summarizes the LOS criteria, as specified in the HCM.

TABLE 8 – LEVEL OF SERVICE CRITERIA

LOS	Control Delay (sec/veh)	
	Signalized Intersection	Unsignalized Intersection
A	0-10	0-10
B	>10-20	> 10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50

Source: Highway Capacity Manual, 2010

LOS designation is reported differently for signalized and unsignalized intersections. Thus, the delay ranges differ slightly between unsignalized and signalized intersections due to driver expectations and behavior for each LOS. For signalized intersections, LOS is defined in terms of delay, which is a measure of driver discomfort and frustration, and lost travel time. For unsignalized intersections, the LOS analysis assumes that the traffic on the mainline is not affected by traffic on the side street. The LOS for each movement is calculated by determining the number of gaps

that are available in the conflicting traffic stream. The delay and LOS for all locations, including individual movements, is included in **Appendix B-2** through **B-4**.

The overall intersection delay and LOS for the 11 signalized intersections in the study area is summarized in **Table 9**.

TABLE 9 – EXISTING (2016) SIGNALIZED DELAY AND LOS

Signalized Intersection (reference #)	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1. Timberlake Road at Waterlick Road	51.4	D	52.7	D
2. Timberlake Road at Brush Tavern Drive	7.3	A	10.3	B
4. Timberlake Road at Crowell Lane	13.7	B	24.1	C
5. Timberlake Road at Southwood Village	26.4	C	23.8	C
8. Timberlake Road at Big Lots/Carpet One Entrance	11.8	B	12.8	B
11. Timberlake Road at Enterprise Drive/Oakdale Circle	38.5	D	22.6	C
12. Timberlake Road at Greenview Drive	65.7	E	83.8	F
13. Timberlake Road at Laxton Road	44.8	D	36.6	D
17. Timberlake Road at Candlewood Court	6.0	A	7.8	A
19. Timberlake Road at Old Graves Mill Road/Dreaming Creek Drive	40.5	D	43.0	D
29. Timberlake Road at Richland Drive/Leesville Road	49.0	D	55.5	E
Total Delay	355.10	N/A	352.5	N/A

As expected, the intersections of Waterlick Road, Greenview Drive, Laxton Road and Leesville Road operate at LOS D or worse during both AM and PM peak hours. Delays at Greenville Road and Leesville Road are the highest in the study area. Approach delay by movement and LOS for the 18 unsignalized intersections in the study area is summarized in **Table 10**.

Figure 14 illustrates the existing LOS and delay.

TABLE 10 – EXISTING (2016) UNSIGNALIZED DELAY AND LOS

Unsignalized Intersection	Movement	AM Peak Hour		PM Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3. Timberlake Road at Tomahawk Drive	Southbound	35.2	E	38.9	E
	Northbound	36.9	E	38.2	E
6. Timberlake Road at Sunny Bank Drive	Southbound	*	*	33.7	D
	Northbound	56.2	F	44.4	E
7. Timberlake Road at Powtan Drive	Southbound	85.3	F	93.5	F
	Northbound	13.5	B	27.5	D
9. Timberlake Road at Shelor Drive	Southbound	59.0	F	119.1	F
	Northbound	14.4	B	21.1	C
10. Timberlake Road at Beechwood Drive	Southbound	158.0	F	140.9	F

Unsignalized Intersection	Movement	AM Peak Hour		PM Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
14. Timberlake Road at Wood Road	Northbound	*	*	12.9	B
	Southbound	502.4	F	260.3	F
	Northbound	*	*	94.2	F
15. Timberlake Road at Knollwood Townhomes/Putt Putt Entrance	Southbound	11.4	B	54.0	F
	Northbound	64.5	F	85.1	F
16. Timberlake Road at Charlie's Chicken/Hooper Plumbing Supply Entrance	Southbound	*	*	*	*
	Northbound	*	*	13.7	B
18. Timberlake Road at TGI Friday's/Bojangles Entrance	Southbound	23.7	C	27.0	D
	N/A				
20. Timberlake Road at Hedges Insurance Agency Entrance	Southbound	20.5	C	18.5	C
	N/A				
21. Timberlake Road at Oakmont Circle	Southbound	38.2	E	129.1	F
	Northbound	48.9	E	39.2	E
22. Timberlake Road at Roundelay Road	Southbound	32.4	D	69.8	F
	Northbound L	67.4	F	118.4	F
	Northbound R	13.9	B	13.1	B
23. Timberlake Road at Timber Ridge Apartments Entrance	Southbound	56.8	F	42.9	E
	Northbound	24.8	C	38.0	E
24. Timberlake Road at Timber Ridge II Apartments Entrance	N/A				
	Northbound	23.9	C	35.5	E
25. Timberlake Road at Whitten Timberlake Chapel Entrance	Southbound	27.6	D	36.1	E
	Northbound	*	*	*	*
26. Timberlake Road at Heritage Business Center Entrance	Southbound	21.8	C	43.8	E
	Northbound	44.9	E	69.3	F
27. Timberlake Road at Misty Mountain Road	Southbound R	11.0	B	12.1	B
	Northbound R	17.8	C	14.6	B
28. Timberlake Road at Middleview Street	Southbound	52.5	F	50.6	F
	Northbound	*	*	25.2	D

*No movement captured during the peak hour.

Of the 18 intersections, 15 operate at LOS E or worse for at least one movement. Of those, 11 operate at LOS F for at least one movement. Given the traffic levels on Timberlake Road during the peak hours, available gaps in the traffic stream are limited, resulting in high delays. During field observations, drivers were observed making an initial right turn, then making a u-turn, rather than waiting for a gap in traffic to make the left-turn movement. **Figure 14** illustrates the LOS and delay by movement and total intersection at each location.

Queuing

In addition to LOS, a queue is the length of the line of cars that arrive at an intersection when the signal is red (or stop sign) combined with vehicles that did not clear the intersection during the previous green light, or able to be processed by a stop sign due to heavy cross street demand. The maximum queue is the probable furthest distance from the stop bar to the back of the last vehicle waiting at an intersection. Comparing the length of this line of vehicles to potential lane lengths available at each intersection provides another measure of 1) how efficiently an intersection processes traffic, and 2) how long turn lanes should be to accommodate queuing. **Figure 15** illustrates existing queuing along the corridor.

The following key locations experience queuing that extends beyond the available storage, or the turn lane access is blocked by adjacent through traffic queuing:

- Waterlick Road (int. #1): eastbound left and westbound left, southbound approach (all lanes)
- Crowell Lane (int. #4): eastbound and westbound left and right
- Southwood (int. #5): eastbound left
- Carpet One/Big Lots (int. #8): northbound right and westbound right
- Enterprise Drive (int. #11): eastbound left and right, and westbound left
- Greenview Drive (int. #12): southbound left/through (only a 40' throat), eastbound left and right, and westbound left and right. Northbound queuing is long for the shared through/left and dedicated right, but the four-lane road (with two approach lanes) ends; therefore, no "storage"
- Laxton Road (int. #13): southbound queuing is long (same issue as northbound Greenview Drive), northbound queuing extends beyond the throat (50') in the Lowes parking lot, eastbound left and right, and westbound left and right
- Wood Road (int. #14): westbound left
- Candlewood Court (int. #17): eastbound left, westbound right and left
- TGI Fridays/Bojangles (int. #18): eastbound left (uncontrolled)
- Old Graves Mills Road (int. #19): southbound approach (all lanes), eastbound right and left, and westbound right and left
- Leesville Road (int. #29): eastbound right and left, westbound right and left, and southbound shared through/right. Northbound queuing is long for the right, but the four-lane road (with two approach lanes) ends; therefore, no "storage"

As growth continues, these locations will experience higher delays and more congestion over time. They provide a good starting point when considering improvements to meet existing and future demand along the corridor. The delay/LOS and queuing for all locations, including individual movements, is included in **Appendix B-2** through **B-4**.

FIGURE 14 A – EXISTING (2016) LOS AND DELAY

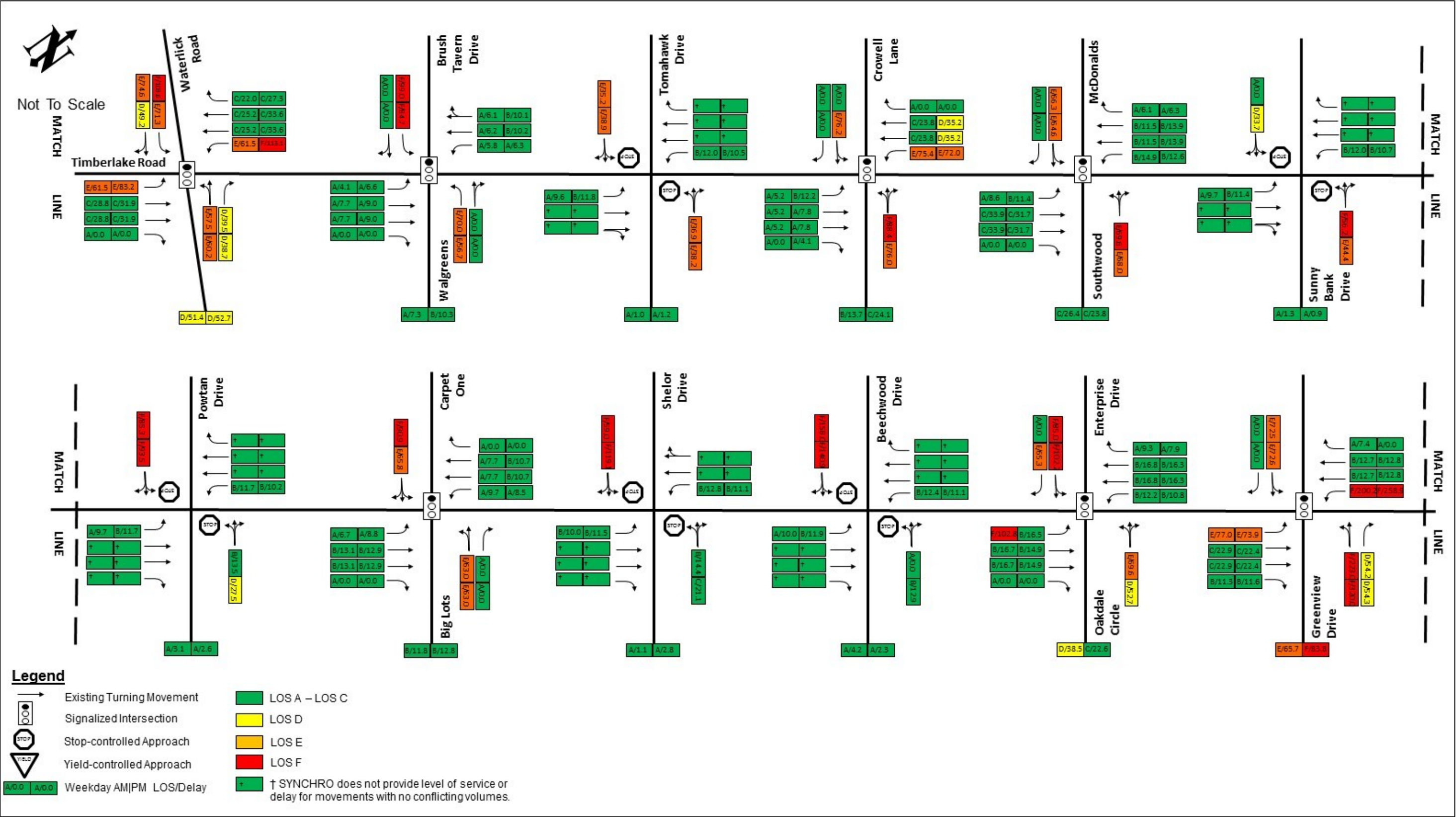


FIGURE 14 B – EXISTING (2016) LOS AND DELAY

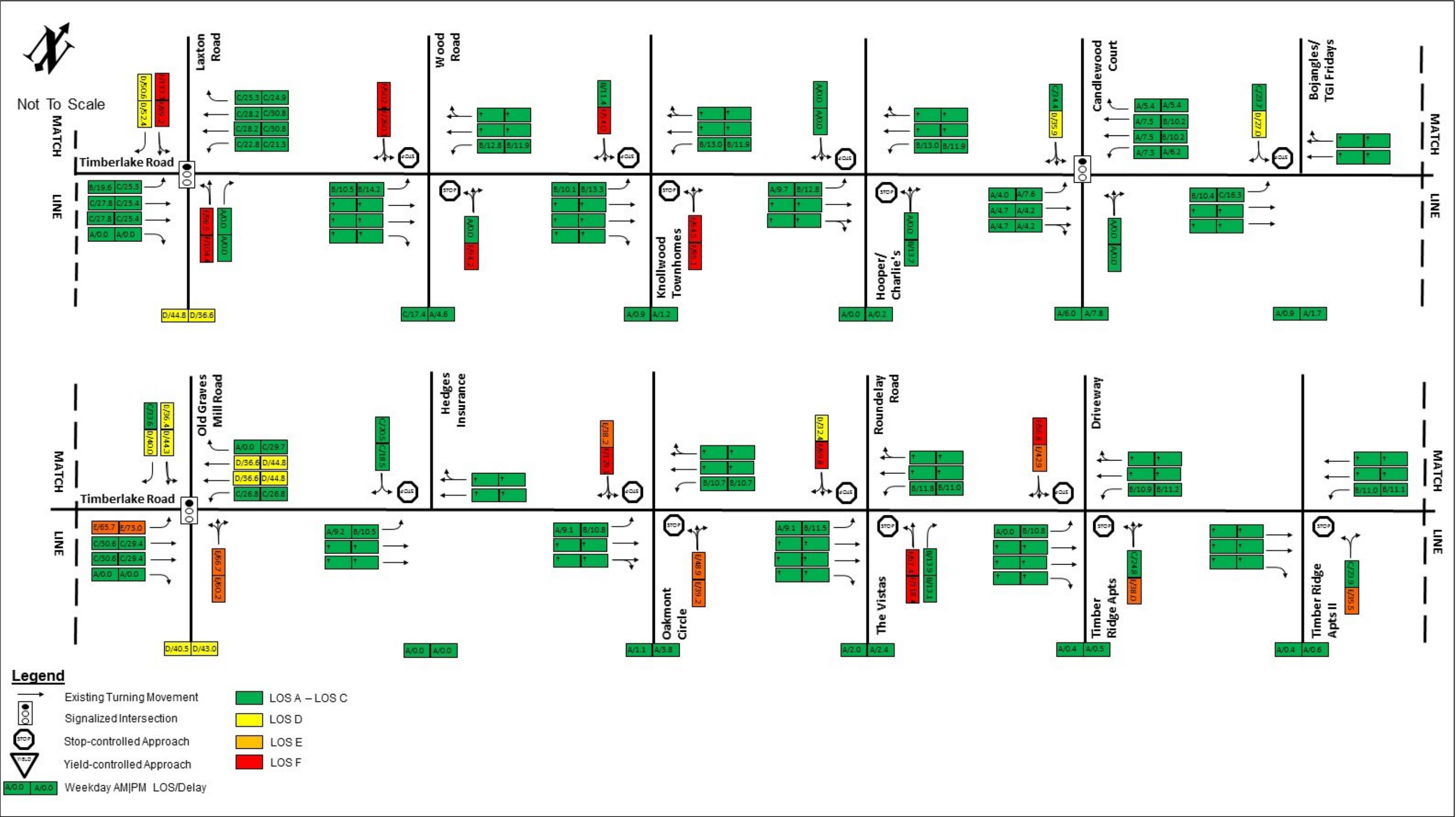


FIGURE 14 C – EXISTING (2016) LOS AND DELAY

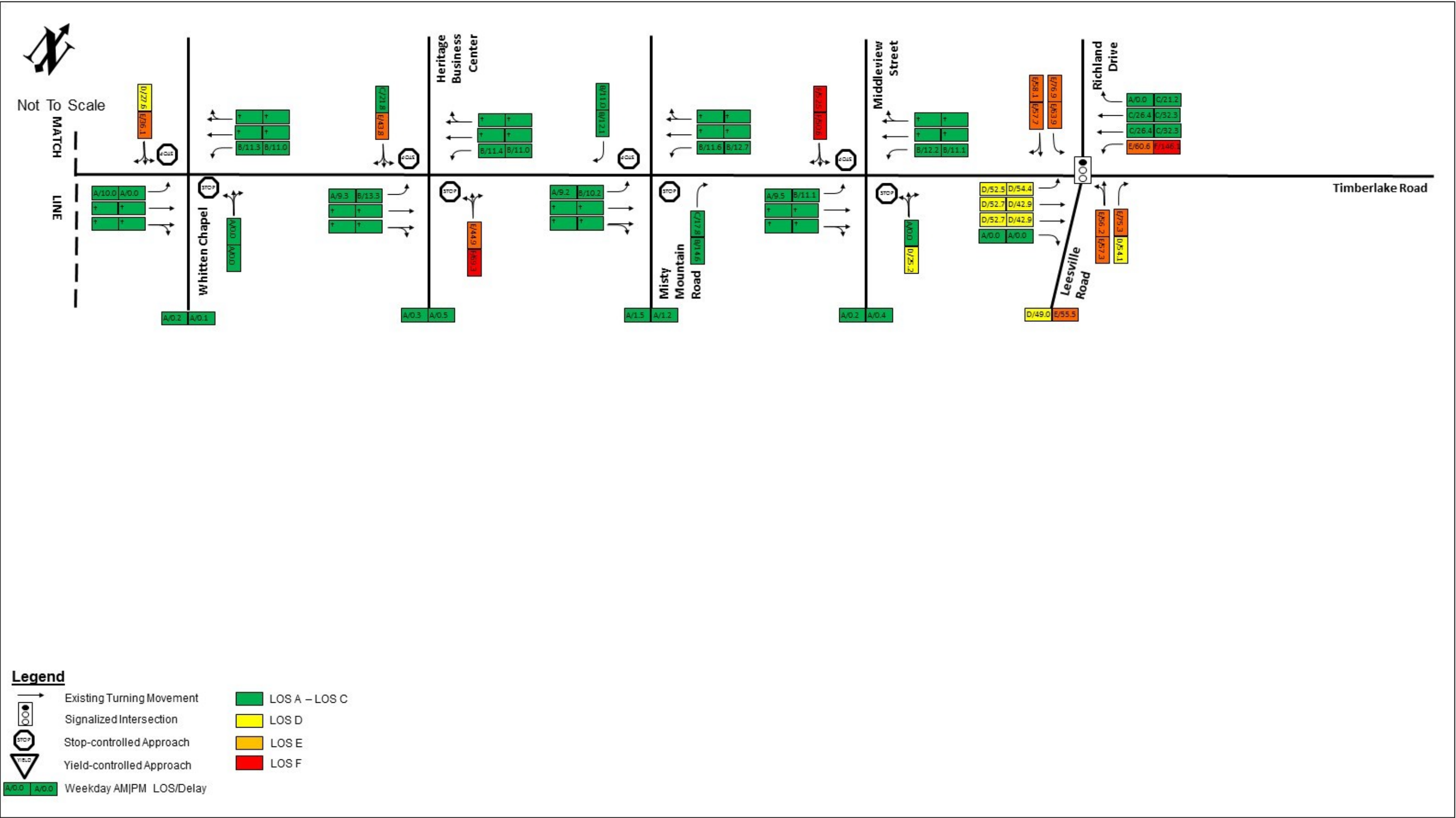


FIGURE 15 A – EXISTING (2016) QUEUING

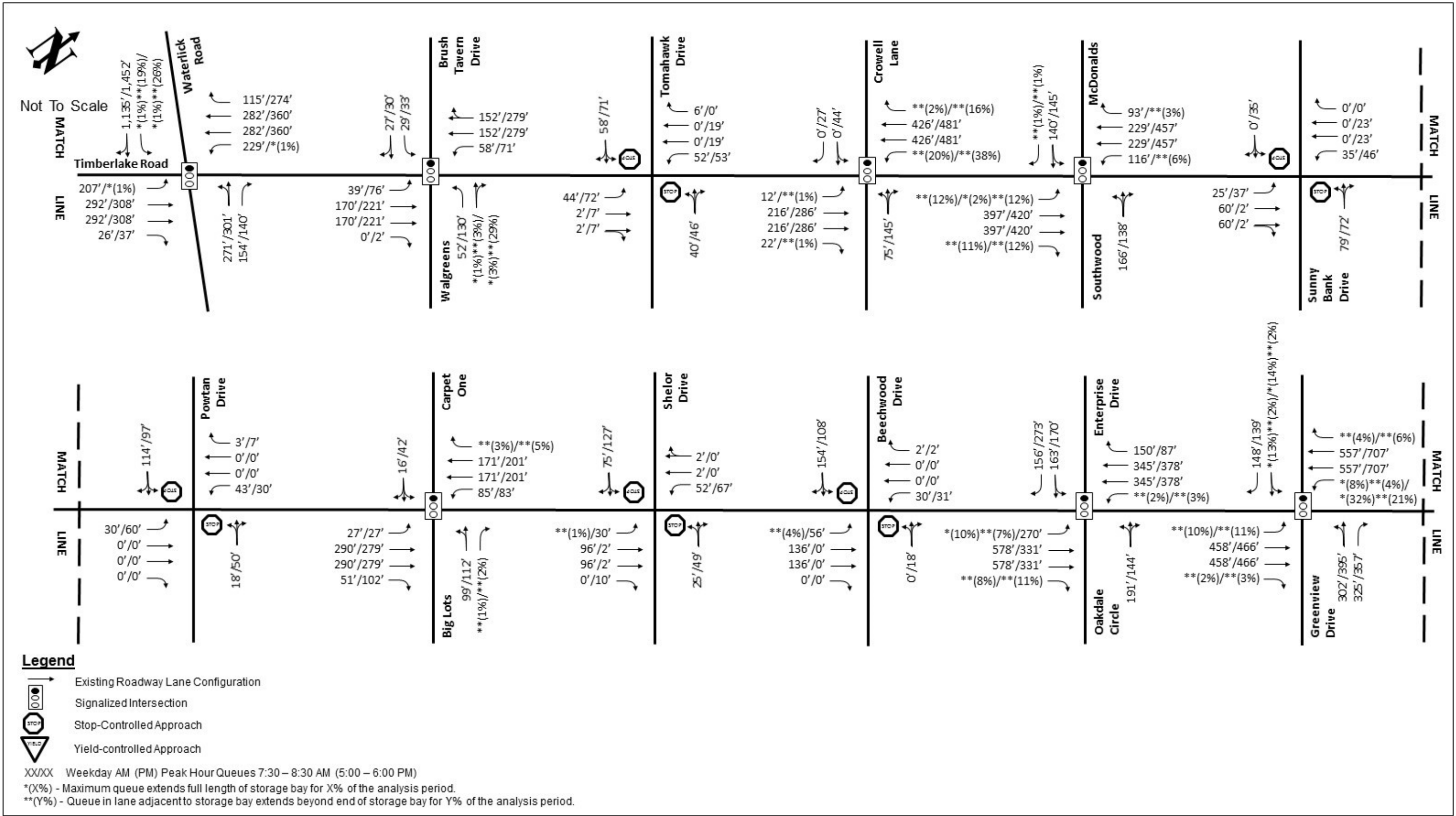


FIGURE 15 B – EXISTING (2016) QUEUING

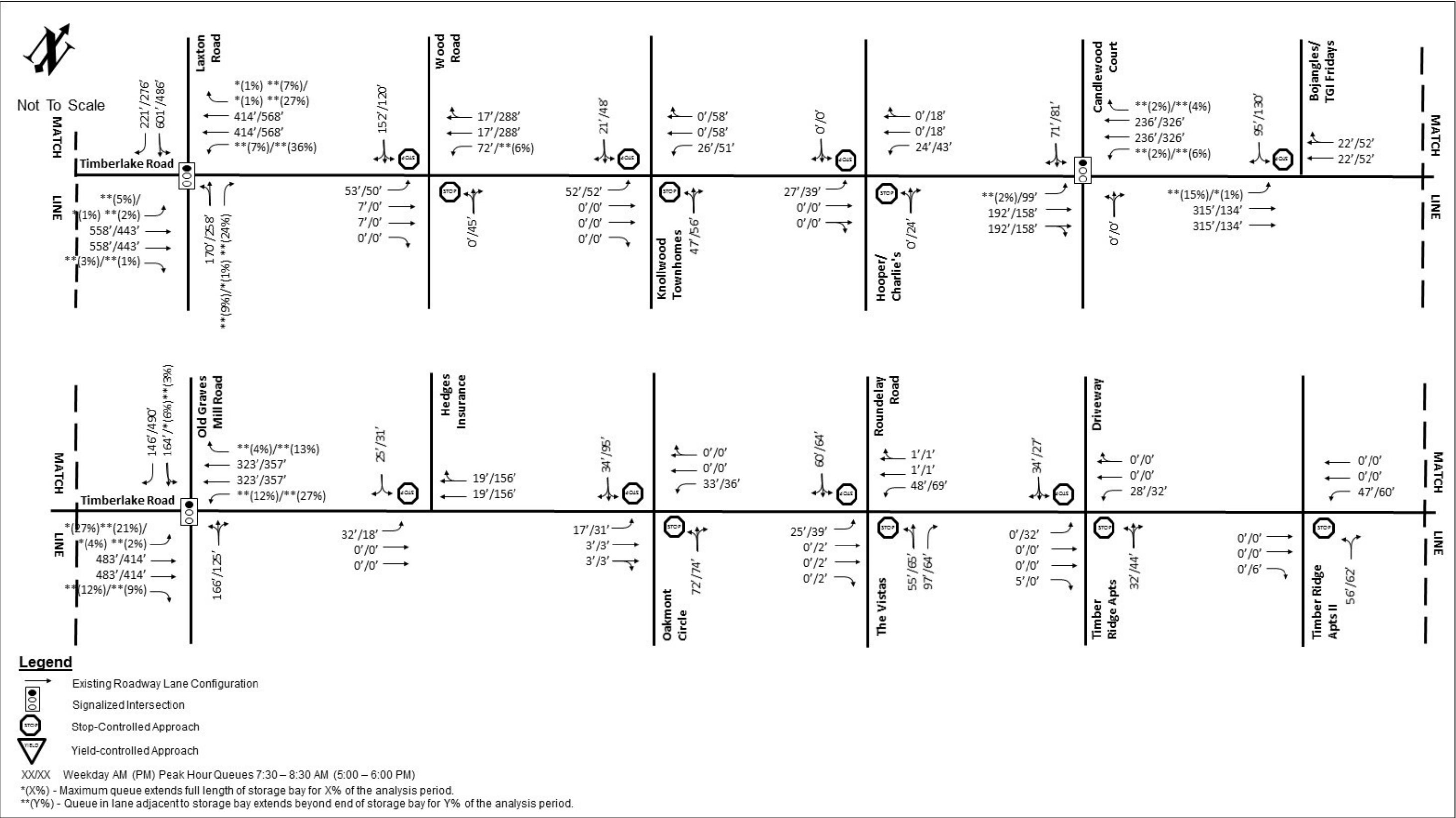


FIGURE 15 C – EXISTING (2016) QUEUING

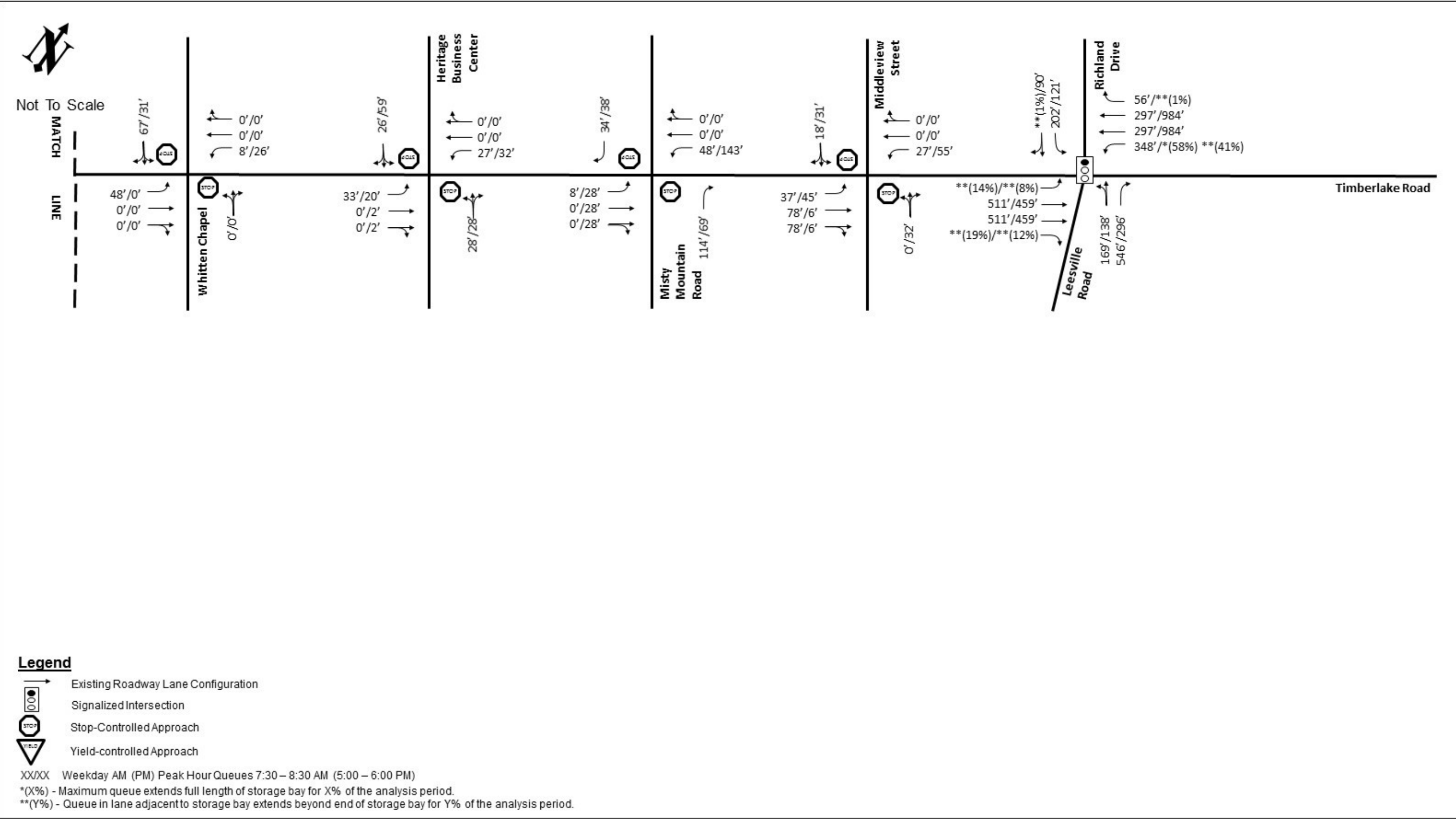


TABLE 11 – VDOT HISTORICAL TRAFFIC DATA

Location	Daily Traffic											Avg Rate
	2005	2006*	2007	2008	2009	2010	2011	2012	2013	2014	2015	
West of Waterlick	16000 ¹	16,000	16,000 ¹	16,000 ¹	16,000 ¹	15,000 ¹	15,000 ¹	15,000 ¹	15,000 ¹	15,000 ¹	16,000 ¹	0.04%
		0.0%	0.0%	0.0%	0.0%	-6.3%	0.0%	0.0%	0.0%	0.0%	6.7%	
Greenview			29,000 ¹	29,000 ²	29,000 ²	27,000 ¹	26,000 ²	26,000 ²	27,000 ¹	27,000 ²	29,000 ²	0.08%
				0.0%	0.0%	-6.9%	-3.7%	0.0%	3.8%	0.0%	7.4%	
Laxton	31,000 ³	31,000	31,000 ¹	31,000 ²	31,000 ²	31,000 ²	31,000 ²	31,000 ²	30,000 ¹	30,000 ²	32,000 ²	0.34%
		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-3.2%	0.0%	6.7%	
Lynchburg CL	31,000 ³	31,000	31,000 ³	31,000 ³	31,000 ³	30,000 ³	29,000 ³	29,000 ³	30,000 ³	30,000 ³	32,000 ³	0.36%
		0.0%	0.0%	0.0%	0.0%	-3.2%	-3.3%	0.0%	3.4%	0.0%	6.7%	
Old Graves Mill	31,000 ²	31,000	31,000 ²	31,000 ²	31,000 ²	30,000 ¹	29,000 ²	29,000 ²	30,000 ¹	30,000 ²	32,000 ²	0.36%
		0.0%	0.0%	0.0%	0.0%	-3.2%	-3.3%	0.0%	3.4%	0.0%	6.7%	
Leesville	27,000 ²	25,500	24,000 ¹	24,000 ²	24,000 ²	26,000 ¹	25,000 ²	25,000 ²	24,000 ¹	24,000 ²	26,000 ²	-0.26%
		-5.6%	-5.9%	0.0%	0.0%	8.3%	-3.8%	0.0%	-4.0%	0.0%	8.3%	
East of Leesville	33,000 ²	31,500	30,000 ¹	30,000 ²	30,000 ²	33,000 ¹	32,000 ²	32,000 ²	32,000 ¹	32,000 ²	34,000 ²	0.39%
		-4.5%	-4.8%	0.0%	0.0%	10.0%	-3.0%	0.0%	0.0%	0.0%	6.3%	
Total Average Rate												0.19%

*No traffic data available; therefore, average between 2005 and 2007

- 1. Continuous or short-term count
- 2. Factored count with growth element
- 3. AADT of similar link

The 10-year history indicates a relatively flat trend in traffic demand. However, ADTs in the study area have ranged from 24,000 up to 34,000 vehicles per day (vpd), perhaps due to fluctuations from the recent recession (2008 to 2011). For these reasons, the historical trend is important to recognize, but not the only data to consider when determining an appropriate growth rate.

Regional Travel Demand Model – Traffic Projections

The Central Virginia MPO maintains a regional travel demand model (TDM). A TDM is an analytical tool to support policy decision making and utilizes a traditional four-step trip-based model process consisting of trip generation, trip distribution, mode choice, and trip assignment. The model has a base year of 2007, a 2035 mid-year, and a planning horizon year of 2040. Growth rates are based on interpolation between the base year and 2040. Linear growth rates by segment along Timberlake Road are summarized in Table 12.

Traffic Forecasting

To understand future traffic conditions in the study area and assess the long-term benefits of proposed improvements, traffic volumes were forecasted to 2030. The following sections describe the methodology for developing traffic growth rates and projecting future traffic volumes for the study area.

Traffic Growth Rate Development

The following sources were reviewed to determine a growth rate (s) to apply to existing traffic volumes to obtain or projected 2030 traffic volumes:

- Relevant development proposals
- Historical traffic demand
- Regional travel demand model
- Transportation analysis zones
- VDOT’s State Planning System database
- VDOT’s published Count Books

The growth rate (s) will be applied to existing traffic counts to develop traffic projections for use in the analysis of future conditions for the study corridor.

Relevant Development Proposals

Relevant development proposals that have been completed in the study area that may potentially increase traffic demand were collected and reviewed. The same four (4) proposals summarized under Existing Conditions were found to have completed the following traffic studies:

- Powtan Drive transportation impact study relating to potential redevelopment efforts
- Candlewood Court transportation impact study for the multiuse Dreaming Creek development
- Elements at Old Graves Mill Road transportation impact study for a residential development
- Petition of Carriage Square rezoning of 16 acres to increase residential density (not a traffic study, but an increase in density compared to the original proposal)

The Dreaming Creek development located on the south side of Timberlake Road west of Graves Mill Road is the largest development being considered. Once built out, the development is expected to produce several hundred new trips during the AM and PM peak hours. The remaining proposals are also located west of Old Graves Mill Road; therefore, consideration will be given to Timberlake Road from Waterlick Road to Old Graves Mill Road as a higher growth segment of the study area.

Historical Traffic Demand

VDOT maintains a statewide traffic count database that is updated and published on an annual basis. The amount and detail of collected traffic count data varies from roadway to roadway and from year to year. Some roads are counted nearly every year while others may only be counted once every several years. Years not counted are typically extrapolated based on count history or factored based on similar counts collected in the area. Year over year growth rates and the average rate by location along Timberlake Road are summarized in Table 11.

TABLE 12 – TDM LINEAR GROWTH RATE PROJECTIONS

Location on Timberlake Road	Daily Traffic		Growth Rate (Linear)
	2007	2040	
West of Waterlick	22,313	23,440	0.15%
Waterlick - Powtan	25,351	34,464	1.09%
Powtan-Enterprise	31,687	32,819	0.11%
Enterprise-Greenview	29,654	32,819	0.32%
Greenview-Laxton	28,787	33,040	0.45%
Laxton-Candlewood	32,209	33,915	0.16%
Candlewood Ct - Old Graves Mill	29,534	33,915	0.45%
Old Graves Mill - Timber Ridge II Apartments	23,153	35,485	1.61%
Timber Ridge II Apartments - Chapel	26,243	35,485	1.07%
Whitten Timberlake Chapel - Leesville	26,731	44,977	2.07%
East of Leesville	35,348	31,310	-0.35%
Average of the ADTs	28,274	33,788	0.59%
	Average Rate		0.65%

Source: CVMPO

The calculated projected future traffic growth rates show minimal to moderate growth in the study area – 0.65% annually on average. However, results do indicate slightly higher rates east of Old Graves Mill Road when compared to rates west of Old Graves Mill Road. To note, the 2007 daily traffic volumes are consistent with those collected on Timberlake Road for the purposes of this corridor study.

Transportation Analysis Zone Population Projections

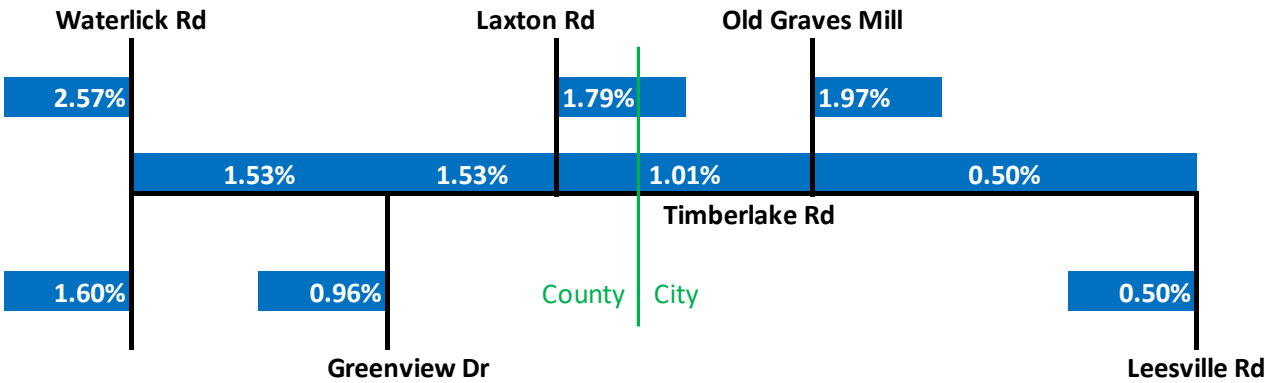
The Census defines transportation analysis zones (TAZ) as a special-purpose geographic entity delineated by state and local transportation officials for tabulating traffic related data from the decennial census, especially journey-to-work and place-of-work statistics from the Census Transportation Planning Package distributed by the Federal Bureau of Transportation Statistics. The primary determining factor for creating TAZ boundaries is to provide for adequate loading on the regional transportation model major street network that was used for the Central Virginia Long Range Transportation Plan Year 2040 as well as other transportation planning activities.

Data from the TAZs was used to make estimates for the **year 2013 as a base year for data analysis** and projections for the year 2040. However, the 2010 population numbers were derived from the 2010 census block and used as the baseline to estimate population change to 2040. The TAZs near Timberlake Road (16 total) were extracted and reviewed. Results showed the 2010 population of ~21,600 residents will increase to ~25,700 by 2040, a 0.63% annual increase (linear). Employment figures were also reviewed, and results were nearly identical to population. To note, this linear rate is also very close to the 0.65% rate derived from the TDM traffic projections.

VDOT Statewide Planning System

VDOT’s resources for statewide planning include a database of projected traffic volumes for key routes throughout the state. This database, referred to as the Statewide Planning System (SPS), provides guidance to planners relative to using a consistent system for traffic forecasting. The SPS data is generally derived through inspection of historical growth rates, and in areas that utilize a regional travel demand model, the SPS data considers the model output which corresponds to forecasted growth within the model area. The most recent year is 2014, with a planning horizon year of 2035. Data from SPS for the Timberlake Road corridor and key cross streets has been summarized in Figure 16.

FIGURE 16 – SPS LINEAR GROWTH RATES (2014 – 2035)



Source: VDOT Statewide Planning System

According to the SPS data, the highest growth in traffic is expected between Waterlick Road and Old Graves Mill. This is consistent with the proposed development patterns. Rates along this segment, including cross streets, range from 0.96% to 2.57%. Timberlake Road east of Old Graves Mill to Leesville Road are expecting to see growth at the rate of about 0.5% annually.

Traffic Growth Rate Application

Multiple sources were reviewed to determine an appropriate growth rate for a 14-year time horizon (2016 to 2030). As a result, a 1.25% annual linear growth rate was applied to Timberlake Road between Waterlick Road and Old Graves Mill Road, and a 0.75% annual linear growth rate was applied between Old Graves Mill Road and Leesville Road. These rates offer a balanced approach to the sources identified in this section and have been reviewed and approved by the Study Work Group.

Project Traffic Volumes

Linear traffic growth rates were applied to existing (2016) turning movement traffic counts to develop future (2030) traffic projections for use in the analysis of future conditions for the study corridor. Figure 2 illustrates the future volumes.

FIGURE 17 A – FUTURE (2030) TURNING MOVEMENT COUNTS

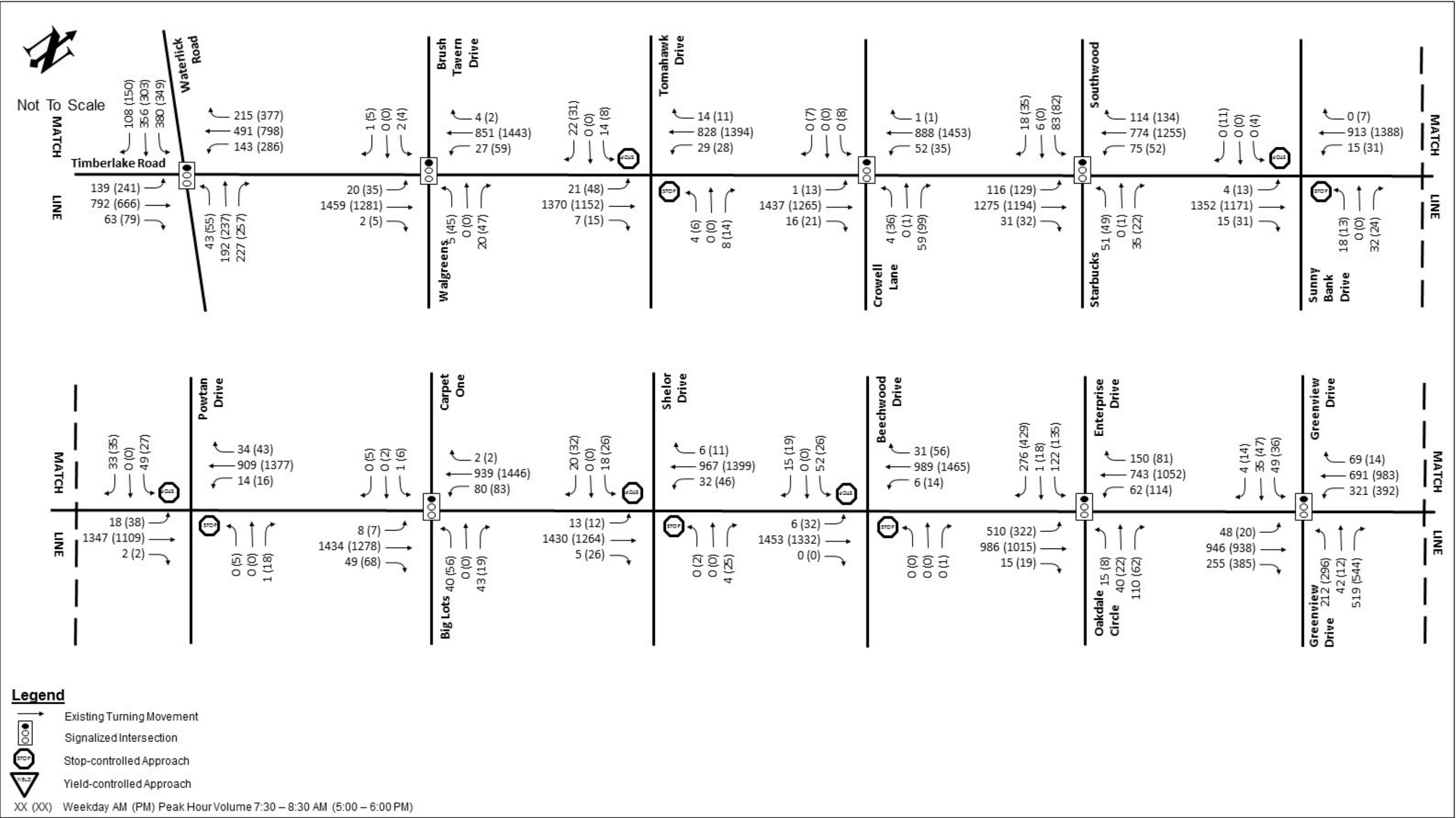


FIGURE 17B – FUTURE (2030) TURNING MOVEMENT COUNTS

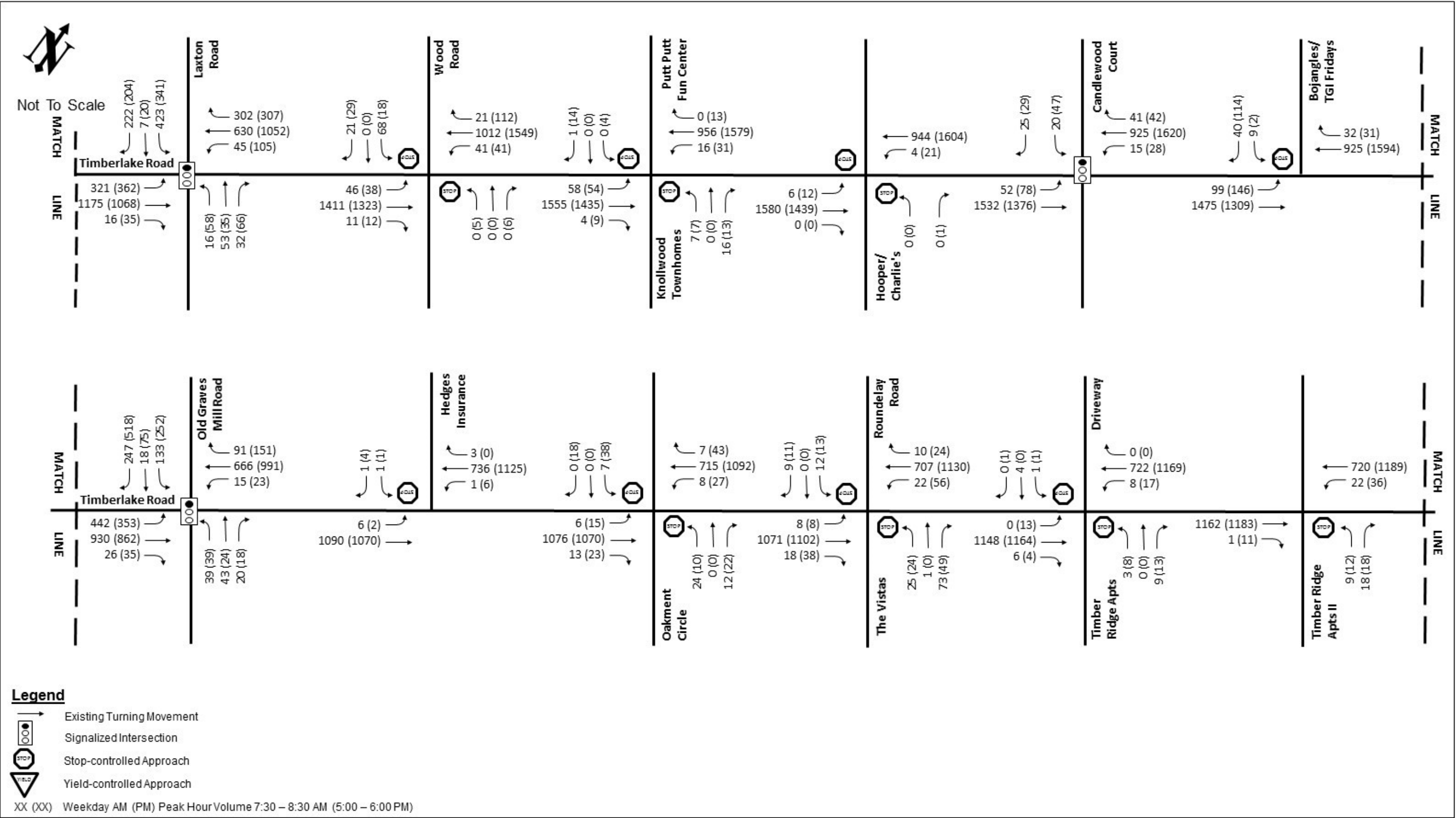


FIGURE 17 C – FUTURE (2030) TURNING MOVEMENT COUNTS

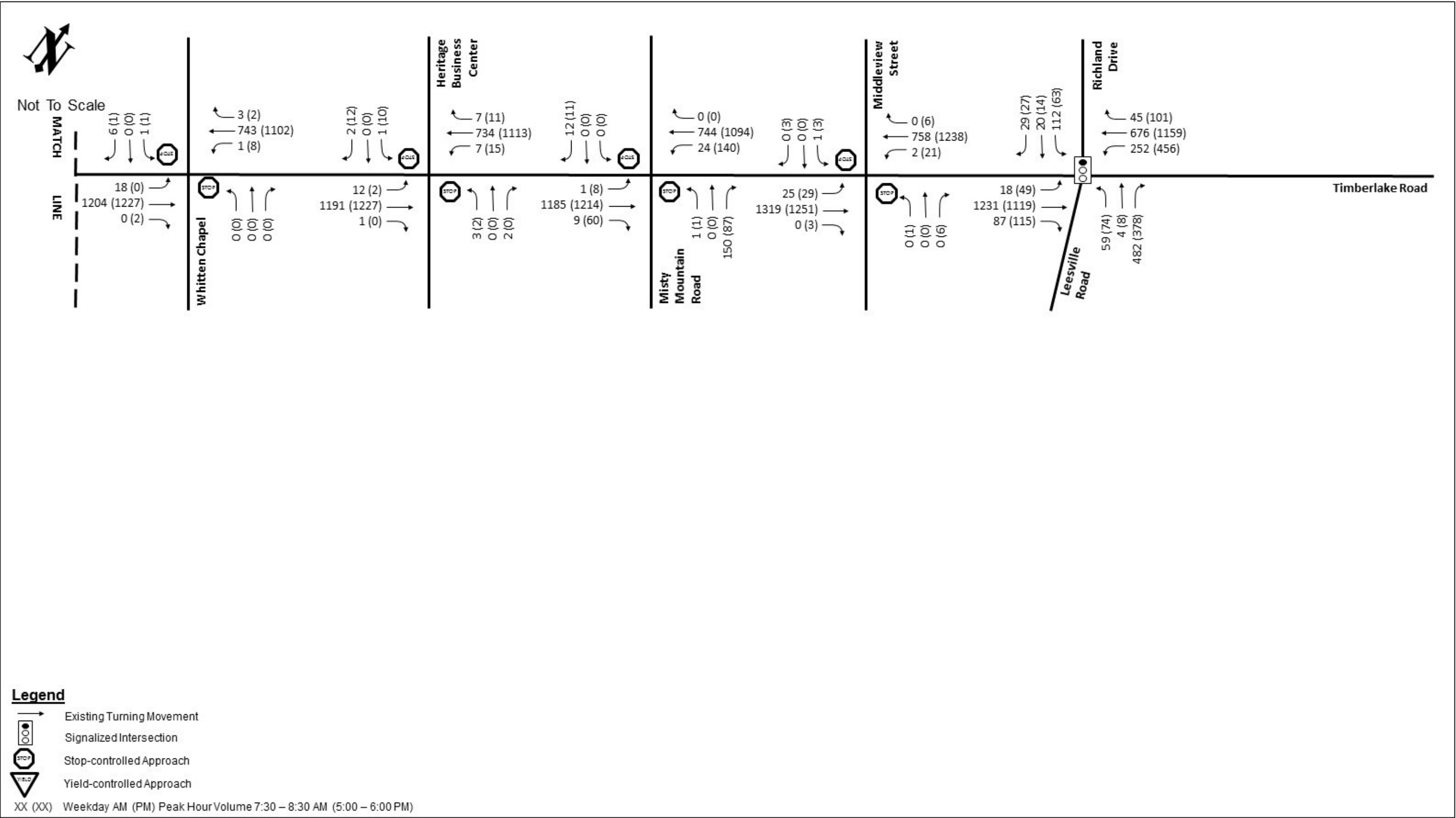


TABLE 13 – FUTURE (2030) SIGNALIZED DELAY AND LOS

Signalized Intersection (reference #)	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1. Timberlake Road at Waterlick Road	66.8	E	51.7	D
2. Timberlake Road at Brush Tavern Drive	8.3	A	12.2	B
4. Timberlake Road at Crowell Lane	15.3	B	27.3	C
5. Timberlake Road at Southwood Village	29.7	C	27.3	C
8. Timberlake Road at Big Lots/Carpet One Entrance	14.0	B	14.8	B
11. Timberlake Road at Enterprise Drive/Oakdale Circle	75.4	E	50.1	D
12. Timberlake Road at Greenview Drive	90.5	F	110.2	F
13. Timberlake Road at Laxton Road	58.7	E	48.6	D
17. Timberlake Road at Candlewood Court	6.8	A	9.3	A
19. Timberlake Road at Old Graves Mill Road/Dreaming Creek Drive	58.5	E	62.8	E
29. Timberlake Road at Richland Drive/Leesville Road	66.9	E	64.3	E
Total Delay	490.9	N/A	478.6	N/A

As expected, delays throughout the study area increase under future conditions. While the planned dual turn lanes off Timberlake Road improve operations for those movements, the intersection still operates at a LOS E during the AM peak hour. The intersections of Enterprise Drive, Greenview Drive, Laxton Road and Leesville Road operate at LOS E or worse during at least one AM or PM peak hour. Greenview Drive operates at LOS F during both AM and PM peak hours.

Approach delay by movement and LOS for the 18 unsignalized intersections in the study area is summarized in **Table 14**.

No-Build Conditions

No-build traffic conditions were analyzed to evaluate the results of future (2030) traffic demand on the existing roadway network. The intent of the no-build conditions analysis is to provide a general understanding of the baseline future traffic conditions that may then be used to evaluate the effectiveness of potential future improvement strategies. Synchro modeling assumptions and analysis results for 2030 no-build conditions are described in the following sections.

Traffic Analysis Assumptions

The existing conditions Synchro model was used as a basis to develop the no-build model. Because this is a future model, planned and approved projects identified through previous efforts that are anticipated along the corridor have been included. The following geometric changes were made to the intersection of Waterlick Road:

- Provision of dual westbound left-turn lanes from Timberlake Road to southbound Waterlick Road
- Provision of dual eastbound left-turn lanes from Timberlake Road to northbound Waterlick Road

No other geometric or traffic signal timing changes were made to the existing Synchro model, but the model was updated with projected 2030 no-build traffic volumes.

Traffic Analysis Results

The same measures of effectiveness used to evaluate existing conditions were used to measure the quantitative performance of the no-build Synchro model:

- Average vehicle delay by movement, approach, and intersection – measured in seconds per vehicle
- Maximum queue length – measured in feet

Delay and Level of Service

Synchro was used to calculate the delay and associated LOS at each study area intersection under no-build conditions. The same methodologies used to analyze existing conditions were also used to analyze no-build conditions. HCM 2010 methodologies were used to analyze all intersections.

The overall intersection delay and LOS for the signalized intersections in the study area is summarized in **Table 13**.

TABLE 14 – FUTURE (2030) UNSIGNALIZED DELAY AND LOS

Unsignalized Intersection (reference #)	Movement	AM Peak Hour		PM Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
3. Timberlake Road at Tomahawk Drive	Southbound	64.1	F	82.8	F
	Northbound	68.2	F	71.7	F
6. Timberlake Road at Sunny Bank Drive	Southbound	*	*	61.5	F
	Northbound	157.5	F	93.5	F
7. Timberlake Road at Powtan Drive	Southbound	293.7	F	325.9	F
	Northbound	15.1	C	45.8	E
9. Timberlake Road at Shelor Drive	Southbound	152.1	F	444.8	F
	Northbound	16.4	C	29.0	D
10. Timberlake Road at Beechwood Drive	Southbound	532.5	F	483.5	F
	Northbound	*	*	14.2	B
14. Timberlake Road at Wood Road	Southbound	1484.2	F	997.7	F
	Northbound	*	*	276.4	F
15. Timberlake Road at Knollwood Townhomes/Putt Putt Entrance	Southbound	12.2	B	158.8	F
	Northbound	166.5	F	263.8	F
16. Timberlake Road at Charlie's Chicken/Hooper Plumbing Supply Entrance	Southbound	*	*	*	*
	Northbound	*	*	15.3	C
18. Timberlake Road at TGI Friday's/Bojangles Entrance	Southbound	38.2	E	55.6	F
	N/A				
20. Timberlake Road at Hedges Insurance Agency Entrance	Southbound	29.2	D	21.2	C
	N/A				
21. Timberlake Road at Oakmont Circle	Southbound	48.8	E	272.6	F
	Northbound	73.0	F	58.0	F
22. Timberlake Road at Roundelay Road	Southbound	43.2	E	114.7	F
	Northbound L	100.4	F	219.8	F
	Northbound R	15.1	C	14.0	B
23. Timberlake Road at Timber Ridge Apartments Entrance	Southbound	74.9	F	55.8	F
	Northbound	29.5	D	55.4	F
24. Timberlake Road at Timber Ridge II Apartments Entrance	N/A				
	Northbound	29.5	D	48.3	E
25. Timberlake Road at Whitten Timberlake Chapel Entrance	Southbound	31.9	D	45.9	E
	Northbound	*	*	*	*
26. Timberlake Road at Heritage Business Center Entrance	Southbound	26.0	D	62.1	F
	Northbound	58.5	F	92.9	F
27. Timberlake Road at Misty Mountain Road	Southbound R	11.3	B	12.7	B
	Northbound R	21.0	C	16.0	C
28. Timberlake Road at Middleview Street	Southbound	68.3	F	70.5	F
	Northbound	*	*	29.5	D

*No movement captured during the peak hour.

Of the 18 intersections, 15 operate at LOS E or worse for at least one movement. Of those, 13 operate at LOS F for at least one movement. Given the traffic levels on Timberlake Road during the peak hours, available gaps in the traffic stream are limited, resulting in high delays. During field observations, drivers were observed making an initial right turn, then making a u-turn, rather than waiting for a gap in traffic to make the left-turn movement. The occurrence of these movements will increase under future no-build conditions.

Figure 18 illustrates the LOS and delay by movement and total intersection at each location.

Queuing

The following key locations experience queuing that extends beyond the available storage, or the turn lane access is blocked by adjacent through traffic queuing:

- Waterlick Road (int. #1): eastbound left and westbound left (blocked by queuing on Timberlake Road), southbound approach (all lanes)
- Crowell Lane (int. #4): eastbound and westbound left and right (blocked by queuing on Timberlake Road)
- Southwood (int. #5): eastbound and westbound left and right (blocked by queuing on Timberlake Road)
- Carpet One/Big Lots (int. #8): eastbound left (blocked by queuing on Timberlake Road), westbound right (blocked by queuing on Timberlake Road)
- Enterprise Drive (int. #11): eastbound left and right (extends beyond storage and blocked by queuing on Timberlake Road), and westbound left (blocked by queuing on Timberlake Road)
- Greenview Drive (int. #12): southbound left/through (only a 40' throat), eastbound left and right, and westbound left and right (extends beyond storage and blocked by queuing on Timberlake Road). Northbound queuing is long for the shared through/left and dedicated right, but the four-lane road (with two approach lanes) ends; therefore, no "storage"
- Laxton Road (int. #13): southbound queuing is long (same issue as northbound Greenview Drive), northbound queuing extends beyond the throat (50') in the Lowes parking lot, eastbound left and right, and westbound left and right (extends beyond storage and blocked by queuing on Timberlake Road)
- Candlewood Court (int. #17): eastbound left, westbound right and left (blocked by queuing on Timberlake Road)
- TGI Fridays/Bojangles (int. #18): eastbound left (extends beyond storage)
- Old Graves Mills Road (int. #19): southbound approach (all lanes), eastbound right and left, and westbound right and left (extends beyond storage and blocked by queuing on Timberlake Road)
- Leesville Road (int. #29): eastbound and westbound right and left (extends beyond storage and blocked by queuing on Timberlake Road), and southbound shared through/right. Northbound queuing is long for the right, but the four-lane road (with two approach lanes) ends; therefore, no "storage"

To note, several stop-controlled intersections experience eastbound and westbound queuing as a result of queues extending back from adjacent signalized intersections.

Figure 19 illustrates existing queuing along the corridor.

A baseline future traffic conditions analysis has been completed that can now be used to evaluate – and compare – the effectiveness of potential future improvement strategies. The delay/LOS and queuing reports for all locations, including individual movements, is included in **Appendix C-2** through **C-4**.

FIGURE 18 A – FUTURE (2030) LOS AND DELAY

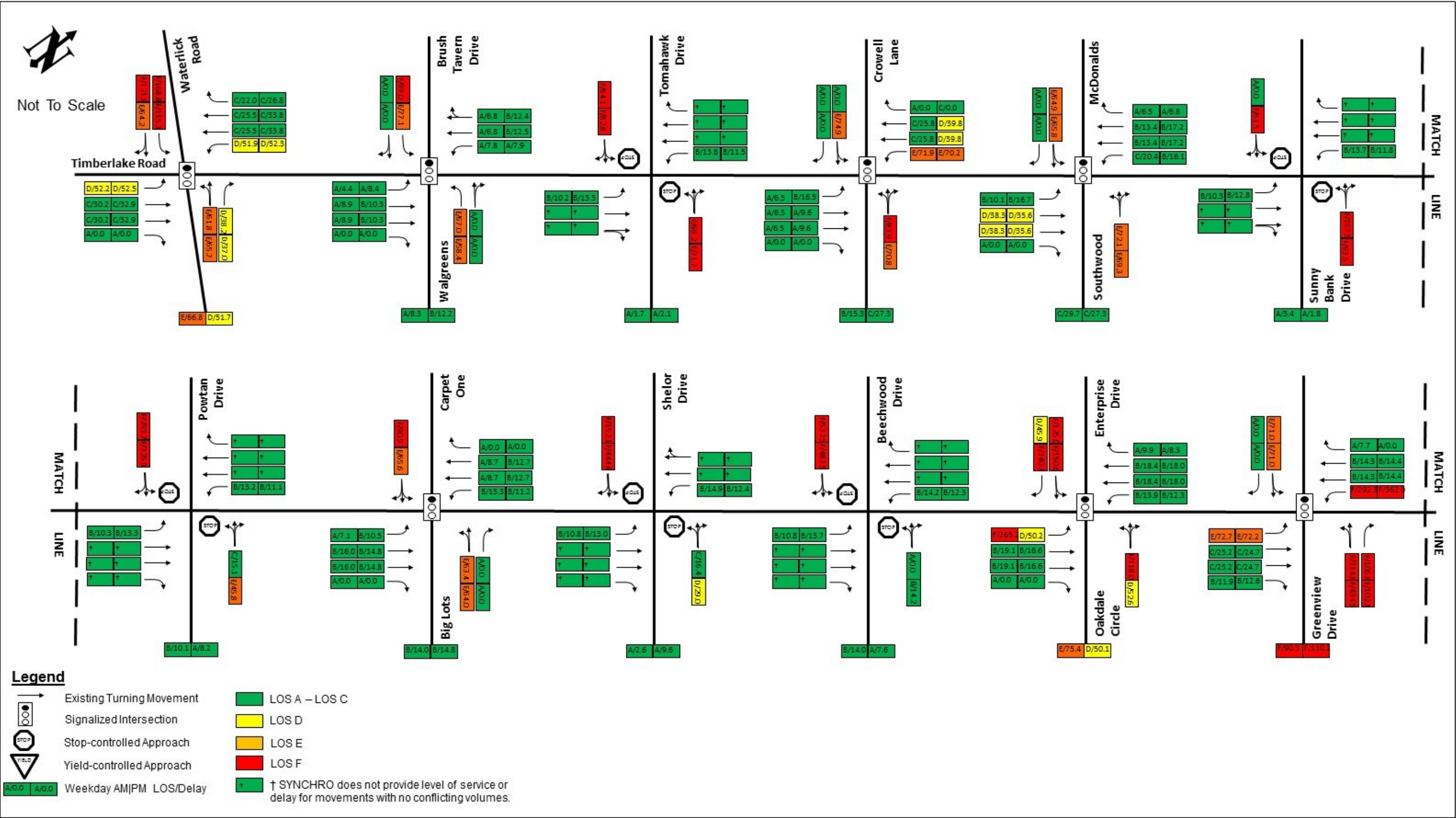


FIGURE 18 B – FUTURE (2030) LOS AND DELAY

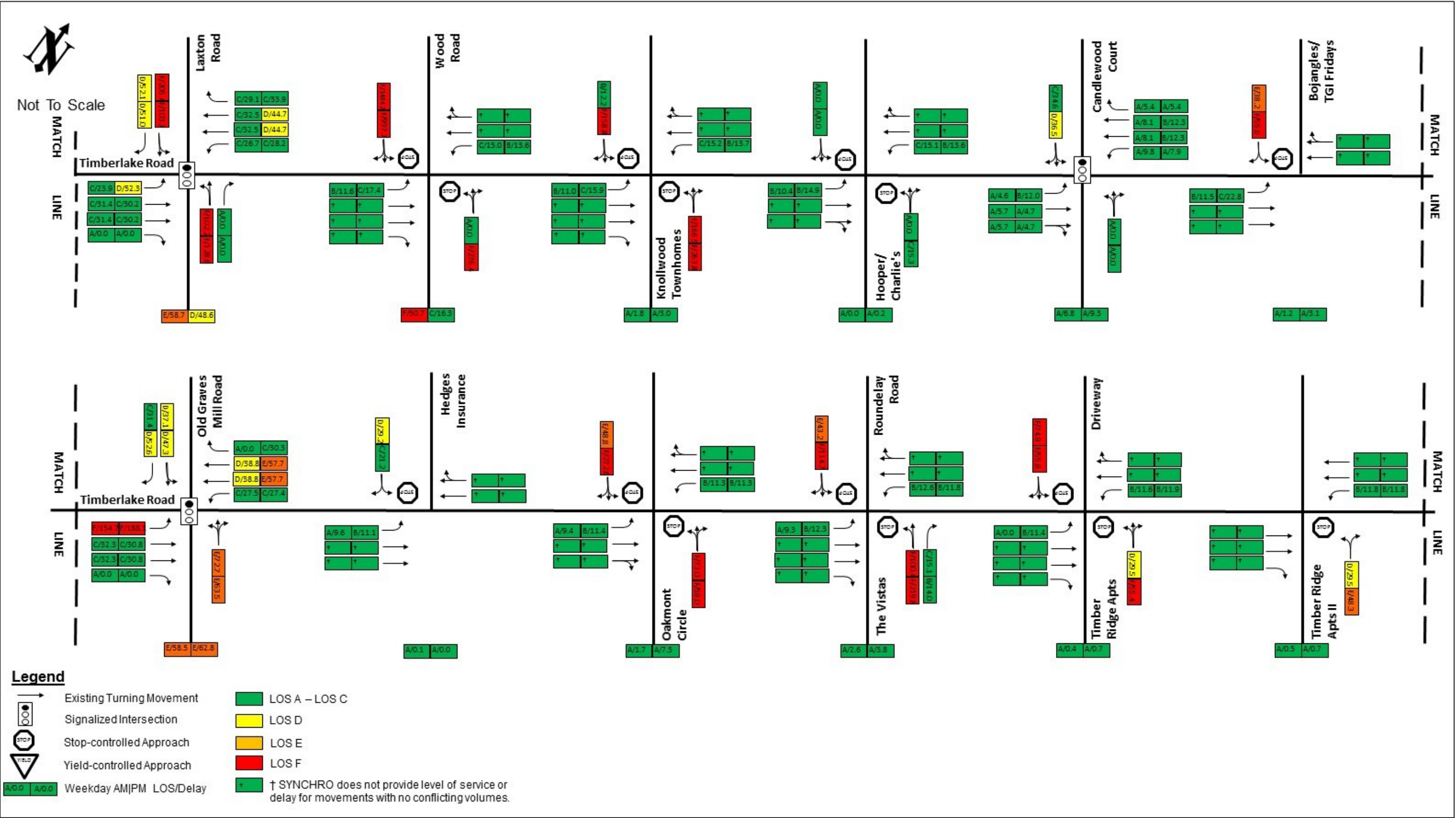


FIGURE 18 C – FUTURE (2030) LOS AND DELAY

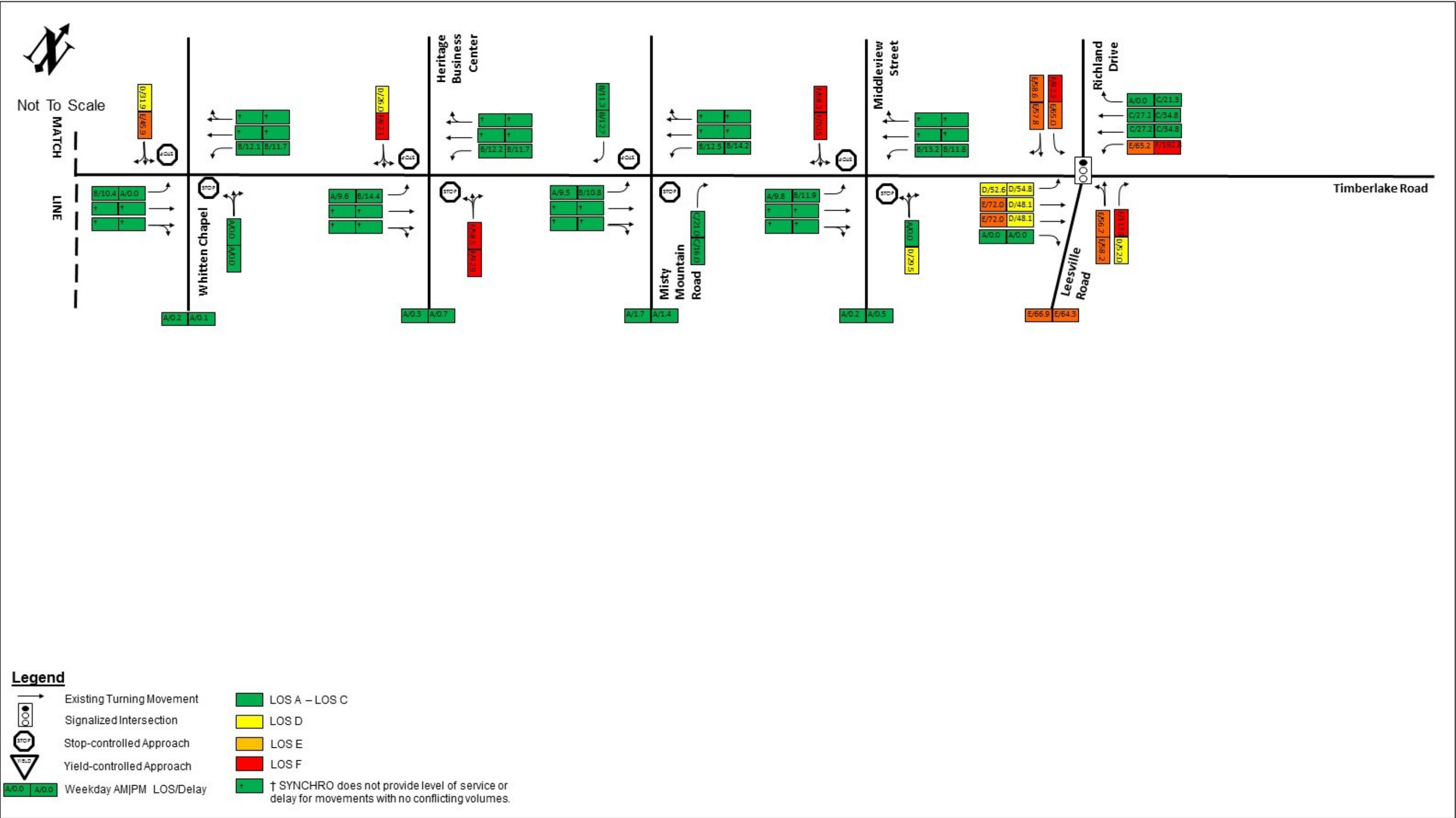


FIGURE 19 A – FUTURE (2030) QUEUING

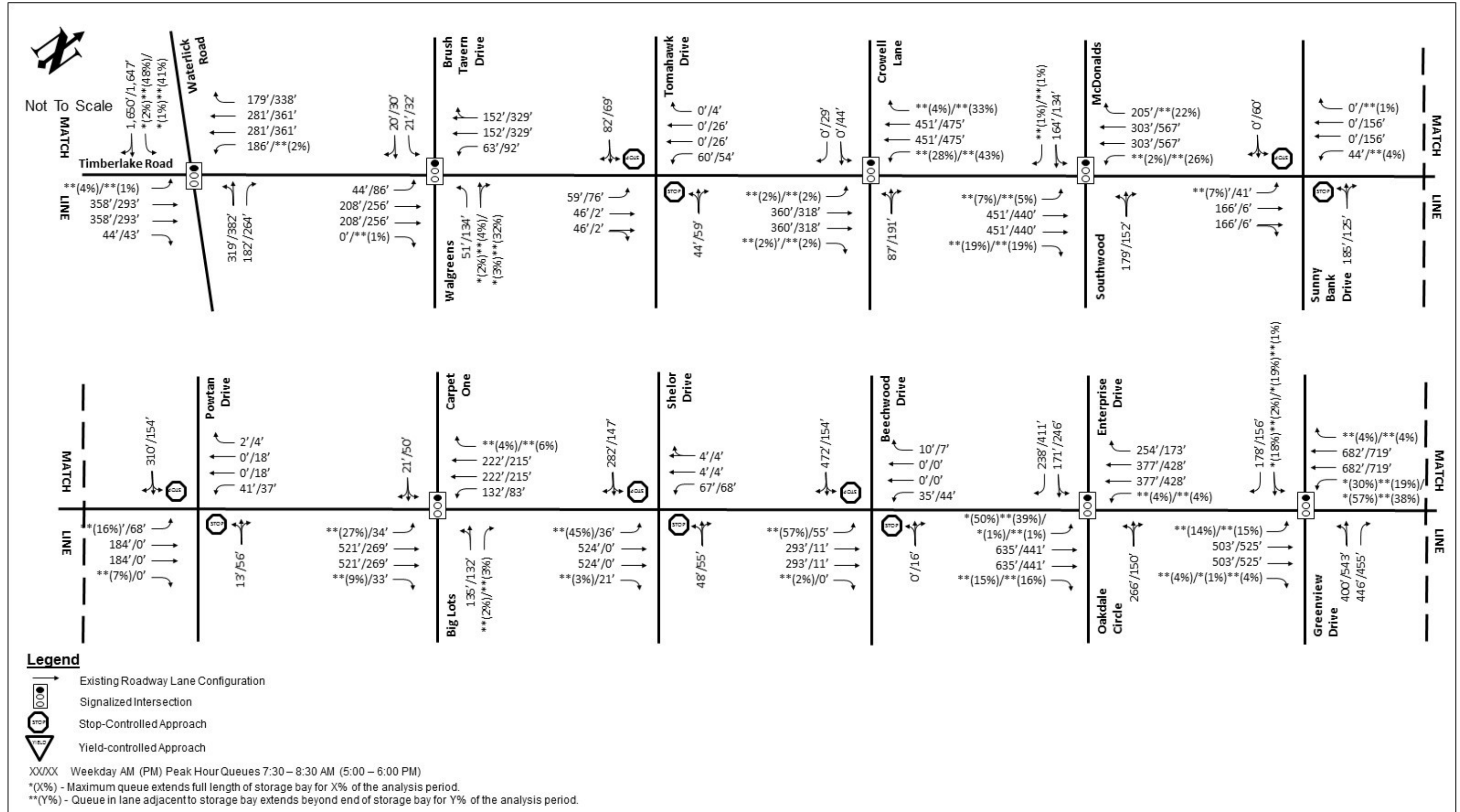


FIGURE 19 B – FUTURE (2030) QUEUING

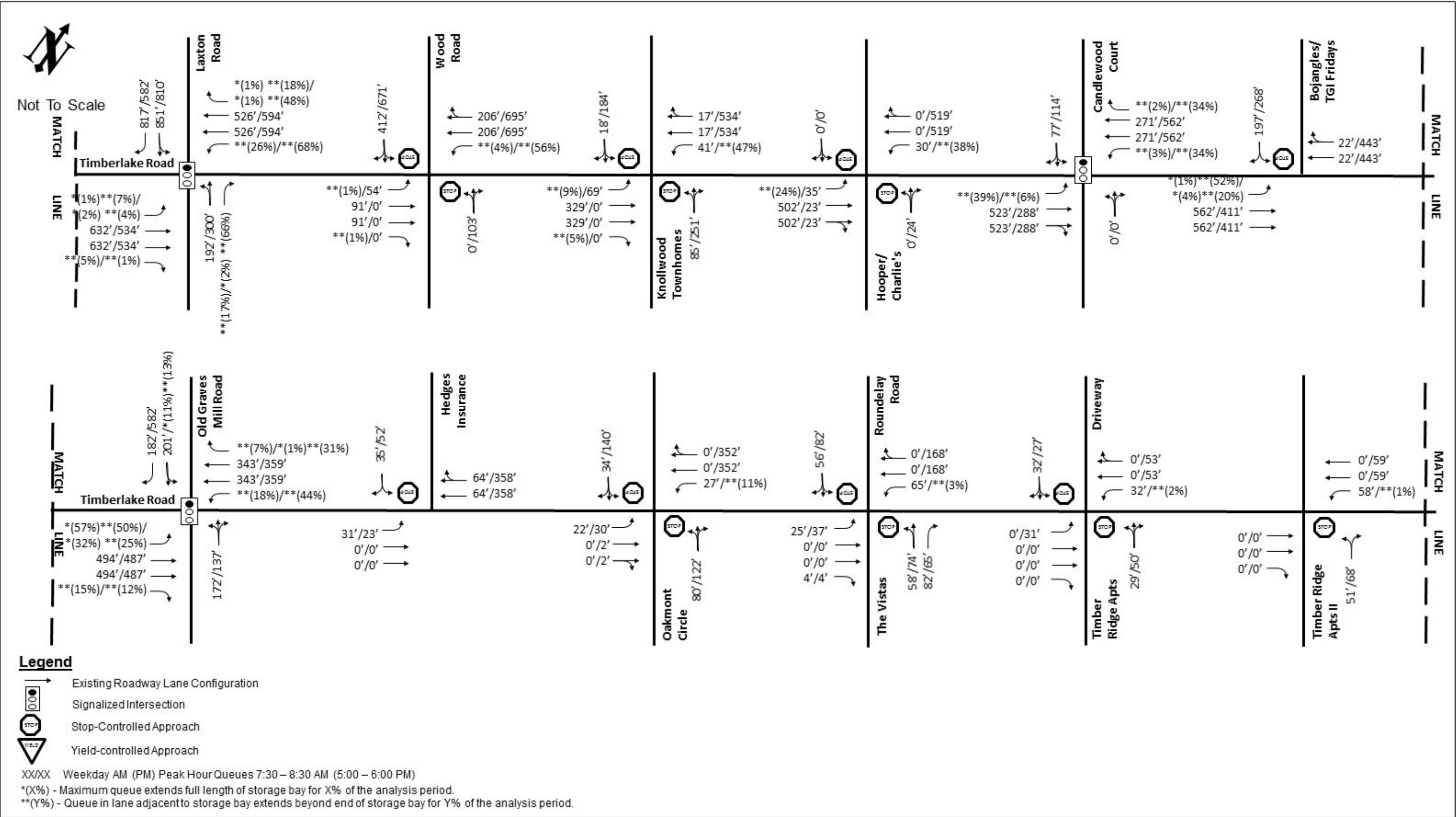
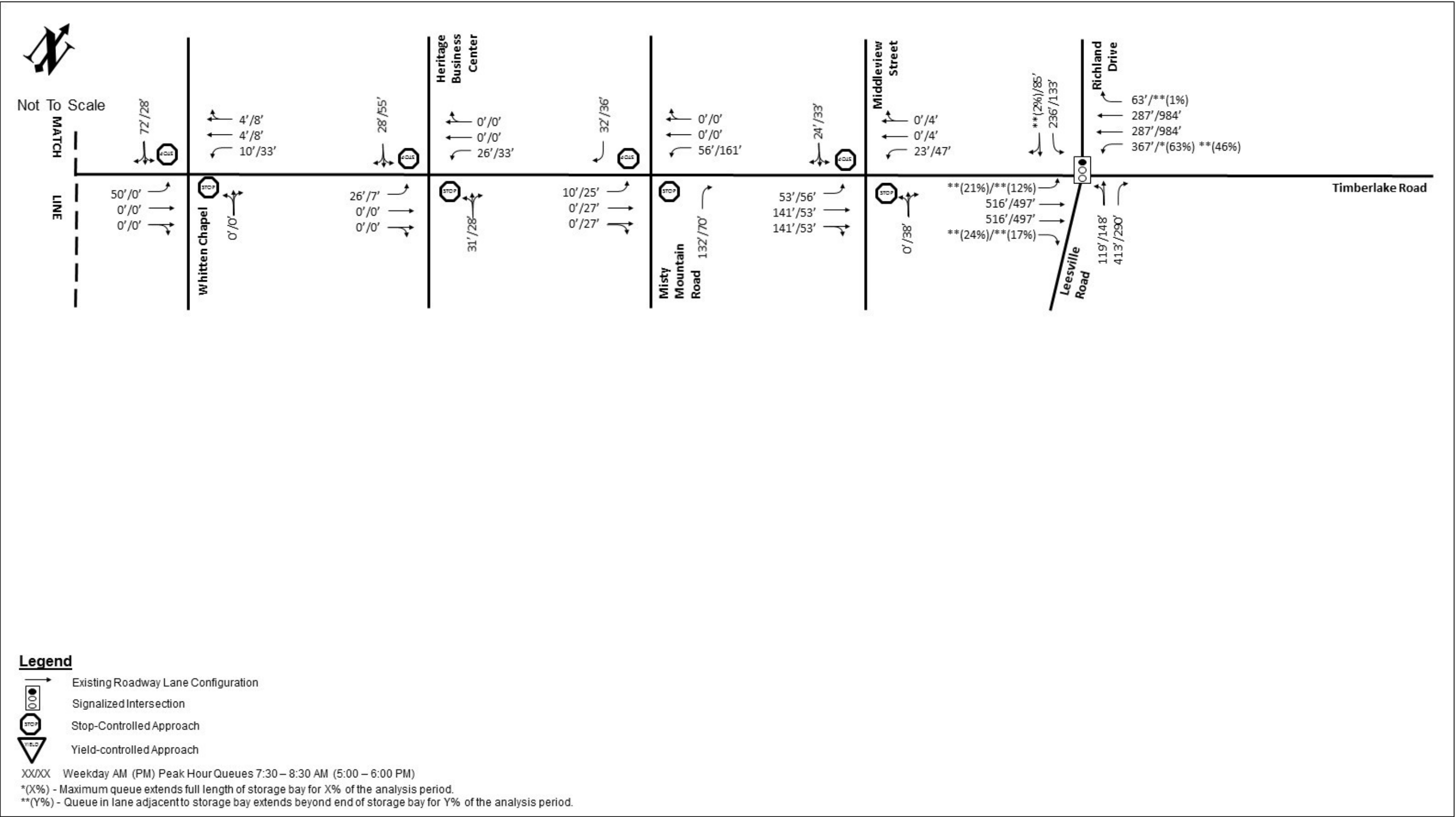


FIGURE 19 C – FUTURE (2030) QUEUING



Improvement Screening and Analysis

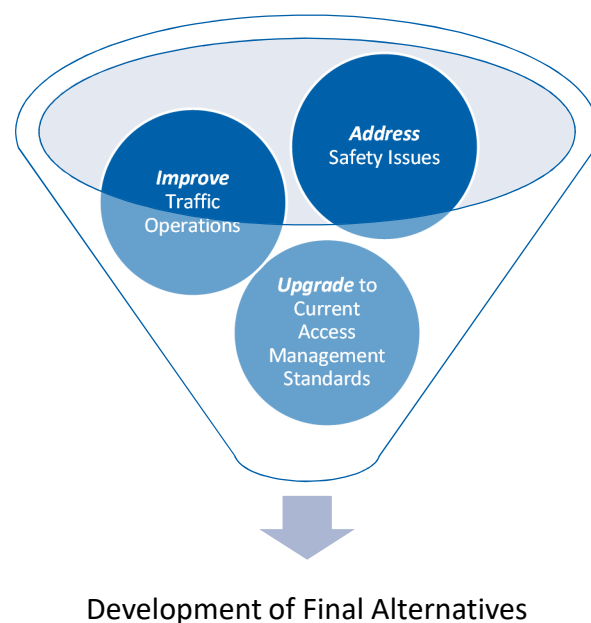
Improvement projects were developed to address safety, geometric, and operational deficiencies along the study corridor identified in the existing and no-build analyses, as well as during field reviews. Alternative concepts were developed through internal meetings/workshops, shared with the SWG at an alternative development workshop, and then screened based on operational analyses, preliminary cost estimates, and feedback on feasibility from the SWG. Based on the screening results, final improvement projects were selected. More detailed design, cost estimates, and schedule estimates were then developed for these selected improvement projects. The following sections describe the concept development, alternative analysis, and improvement project selection.

Concept Development

Now that a baseline of future no-build traffic conditions has been established to evaluate the effectiveness of potential future improvement strategies, the concept development phase can proceed. The following efforts were undertaken in advance of the alternative development workshop with the SWG to ensure the most effective concepts and ideas were presented:

- Completion of no-build – determined needs
- Developed numerous preliminary concepts and ideas to address those needs
- Held internal workshops to initially screen numerous concepts (linework for right-of-way assessment, planning level cost screening, operational analysis)

Once the initial screening process was complete, the SWG participated in an alternative development workshop on May 1, 2017. During this workshop, the potential concepts developed in advance were shared, while other concepts were developed at that time to address deficiencies identified along the corridor. The concepts focused on three (3) key objectives listed below:



The purpose of the workshop was to share a draft list of concepts to be further reviewed and screened by the SWG. It was an open format presentation; therefore, new ideas were also introduced and discussed. From there, improvement alternatives would then be considered for the preferred build condition, and subject to subsequent analyses. To help with this process, the concepts were categorized by the following criteria as part of the alternatives workshop:

- Corridor-wide Improvements
 - Restricted crossing u-turns and median closures
 - Driveway consolidations
 - Signal coordination and possible signal removal
 - Signing improvements
- Intersection Improvements
 - Turn lane and through lane additions
 - Storage and taper length extensions
 - Signal timing adjustments
 - Movement restrictions (right in / right out applications)
 - Alternative intersection designs (displaced left, green t)
- Multimodal Considerations

It's important to note that multiple internal workshops were held in advance of the SWG alternatives workshop to further screen potential projects. Even with initial screening, over 40 preliminary concepts and ideas – some isolated while others corridor-wide – were shared with the SWG. **For this reason, this section of the report summarizes the discussion at the workshop and subsequent analyses for each of the three (3) key objectives, rather than identifying each of the concepts and ideas shared with the SWG.** Details and sketches of the proposed alternative concepts from the workshop presentation are provided in **Appendix D**.

Address Safety Issues

The safety analysis performed on the Timberlake Road study corridor used crash data from the VDOT Roadway Network System (RNS) and covered the period from January 1, 2011 to December 31, 2015. This data was used to identify crash patterns based on crash severity, roadway characteristics, and environmental characteristics. In summary, 661 total crashes were reported within the study area over the five-year crash analysis period. Of the reported crashes, there were 5 fatalities, 200 crashes involving bodily injury, and 456 crashes that resulted in property damage only. The safety issues in the corridor are magnified by the number of median crossovers and the grade separation between the eastbound and westbound lanes. The frequency and severity of crashes are likely to increase under no-build conditions as congestion and driver frustration increases with increased traffic volumes. As noted in the Crash Analysis section,



crashes are generally clustered around intersections that serve heavy turning movements; notably, Waterlick Road, Enterprise Drive to Laxton Road, Graves Mill Road, and Leesville Road. The section of Timberlake Road between Enterprise Drive and Laxton Road has experienced the highest number of crashes. There have also been crashes involving pedestrians along Timberlake Road. Crashes are a result of a number of issues, including:

- Traffic congestion and queuing
- High frequency of driveways and median openings
- Signal operations

When considering improvements along Timberlake Road, locations that experience a high number of crashes, as noted, and particularly those correctable by geometric modifications that reduce conflict points and improve operations were prioritized. However, the improvement itself will be shaped by, and in part determined, through traffic operations and access management considerations, with safety implications noted.

Improve Traffic Operations

Locations that exhibited deficient traffic operations during existing and no-build conditions were identified. As expected, delays throughout the study area only increase under future conditions, if no changes are considered. Of the 11 signalized intersections, the following six (6) will operate at LOS E, or worse for at least one peak hour:

- 1. Waterlick Road
- 11. Enterprise Drive
- 12. Greenview Drive
- 13. Laxton Road
- 19. Old Graves Mill Road
- 29. Leesville Road

The intersection at Greenview Drive will operate at LOS F during both AM and PM peak hours under no-build. The poor operations at Greenview Drive will only exacerbate problems at Enterprise Drive and Laxton Road; therefore, special consideration was given to concepts and ideas that help to alleviate queuing and improve traffic progression along Timberlake Road, not just for an isolated movement. From there, multiple concepts and ideas were developed to address high delays and lengthy queues.

The addition of left turn lanes off Timberlake Road at Greenview Drive and Laxton Road, and the modification of the approaches on Laxton Road, Greenview Drive and Enterprise Drive to accommodate an additional left turn lane were supported by the SWG. Queuing from inadequate storage available in turn lanes spills back into through lanes, blocking progression on Timberlake Road and resulting in upstream impacts in addition to the individual movement. Therefore, dual eastbound left turn at Laxton Road and Enterprise Drive will improve operations for the eastbound left turn and help to reduce the occurrence of a queue that extends back to Greenview Drive. Innovative intersection designs, including the implementation of a “green t” at Enterprise Drive and Greenview Drive, were also considered; however, the right-of-way impacts and associated costs would outweigh the benefits.

At Waterlick Road, a previously planned project is moving forward that will reconstruct the existing single left turn lanes off Timberlake Road; thereby, accommodating protected-permissive phasing (currently protected only). As part of this project, improvements to Waterlick Road include the installation of a median that will restrict access near the intersection’s area of influence. No additional recommendations were made as part of this study, with the exception of improved traffic signal coordination.

Multiple concepts were considered at the intersection of Timberlake Road and Old Graves Mill Road – including dual left turn lanes off Timberlake Road and widening the westbound approach of Timberlake Road. Due to right-of-way and grade constraints, eastbound dual lefts were removed from consideration. Dual southbound right turn lanes were also considered on Old Graves Mill Road, however reconfiguring the approach to accommodate dual lefts was determined to be the best solution to advance. On the westbound approach, the conversion of the outside shoulder to a through lane west to Candlewood Court was also advanced as a preferred alternative. Collectively, these improvements reduced queuing for the eastbound left turn movement to Old Graves Mill Road without needing to widen Timberlake Road.

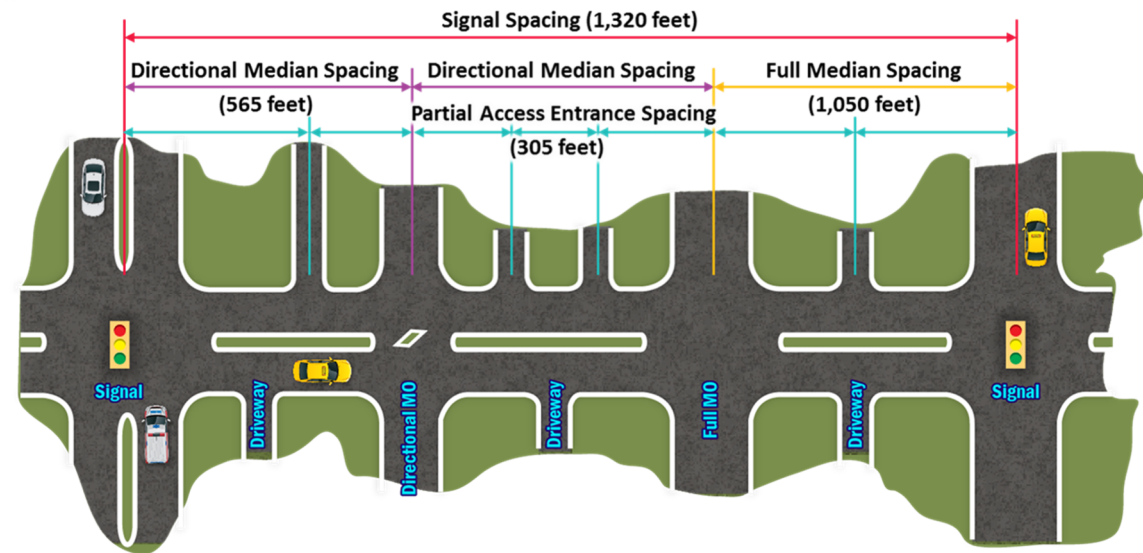
At Leesville Road, the westbound left turn movement will operate at LOS F and queue back well beyond the available storage in the left turn lane. This intersection will experience some of the highest delays along the corridor, second only to Greenview Drive. A signalized restricted crossing U-turn (RCUT) intersection was considered, but downstream traffic impacts could result in the need for additional improvements. Ultimately, the addition of a second westbound left turn lane was advanced as the preferred alternative. This recommendation not only improves the operation of that movement, but Timberlake Road progression as well (LOS E to LOS D, or better for through movements).

Other traffic operational improvements considered include:

- Removing the Brush Tavern Drive signal and closing the median (improvement advanced to preferred)
- Signalization of Powtan Drive (intersection did not meet signal warrants; therefore, improvement not advanced)
- New signal or median RCUT at Beechwood Drive with southside connection to Oakdale Circle (impacts too great for near-term solution; therefore, improvement not advanced)
- Lengthening of turn lanes and tapers to better accommodate queues (most locations advanced to preferred)
- Improve signal coordination (advanced to preferred, in addition to preferred improvements)

Upgrade to Current Access Management Standards

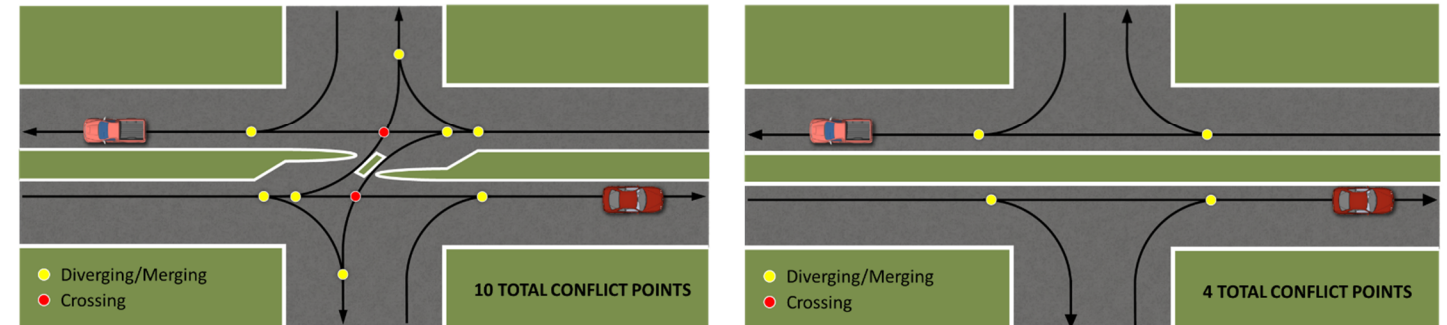
The VDOT Road Design Manual provides Access Management Design Standards for Entrances and Intersections along roadways, which aim to provide access to land uses while preserving the flow of traffic. The access management standards are based on the functional classification of the roadway and legal speed limit.



Timberlake Road does not meet unsignalized intersection / full median crossover spacing requirements for all locations along the corridor. Only five (5) of the 11 signalized locations meet the spacing requirements. To help address deficient access management standards, the implementation of RCUTs, median closures, and turn restrictions were proposed. These recommendations do not change any major street movements and help to improve safety, operations and maintain access management standards. While many locations were considered through internal workshops and discussed with the SWG, the following locations with access management improvements were advanced:

- 2. Brush Tavern Road (signal removal, median closure)
- 3. Tomahawk Drive (RCUT)
- 6. Sunny Bank Drive (RCUT)
- 9. Shelor Drive (median closure)
- 10. Beechwood Drive (RCUT)
- 15. Knollwood Townhomes/Putt Putt Entrance (RCUT)
- 18. TGI Friday's/Bojangles Entrance (turn restrictions)
- 20: Hedges Insurance Entrance (turn restrictions)
- 21. Oakmont Circle (median closure)
- 23. Timber Ridge Apartments I (turn restrictions)
- 24. Timber Ridge Apartments II (turn restrictions)
- 26. Heritage Business Center (median closure)
- 28. Middleview Street (RCUT)

Collectively, these improvements will help to upgrade Timberlake Road to meet current access management standards. Notably, they will also improve safety by reducing vehicle conflict points. For the operational and safety benefits, RCUTs, restricted turns, and median closures are included as part of the preferred build condition.



Multimodal Considerations

While the purpose of the study is to identify operational and safety challenges on the corridor and to develop potential transportation solutions, consideration was also paid to the multimodal environment. Per direction from the SWG, the following multimodal elements are to be consider.

- Transit (with input from the Greater Lynchburg Transit Company (GLTC) and the next Transit Development Plan):
 - Improve existing stops with shelters, benches, lighting, and improved signing
 - Coordinate with GLTC and review most recent TDP for ridership and boardings/alightings
 - Policy consideration – amend development ordinances to require sidewalks along frontage of new development
 - Policy consideration – amend development ordinances to require major trip generators to provide right-of-way for bus pull off (if rezoning or conditional use permit)
- Pedestrian (note there have been multiple fatalities along the corridor involving pedestrians):
 - Pedestrian signal heads and crossings at Leesville Road (school)
 - Consider Safe Routes to School Program support for Heritage and Brookville school areas
 - Addition of sidewalks in coordination with transit planning
 - Review lighting levels at intersections
 - Consider pedestrian features for any new signalized intersections (future)
- Bicycle:
 - Consider advancing recommendations from Region 2000
 - Coordinate with future regional long-range transportation plans (LRTP) and bicycle planning

While these considerations are included as part of this study, implementation will likely fall to the local municipal level. They are not included in the operational modeling or cost estimating.

Preferred Build Conditions (2030)

Preferred build traffic conditions were analyzed to evaluate the results of future (2030) traffic demand on the preferred build roadway network. The intent of the preferred build condition analysis was to evaluate the effectiveness of the selected improvement projects and understand how the improvement projects work in conjunction with one another. Synchro modeling assumptions and analysis results for the 2030 preferred build traffic conditions are described in the following sections.

Traffic Analysis Assumptions

The no-build conditions Synchro model was used as a basis to develop the preferred build conditions model. Roadway geometry and traffic signal timing adjustments were made to reflect the improvement strategies set forth in the previous section. The models were updated with rerouted future (2030) traffic volumes to account for changing traffic patterns primarily due to geometric changes in the preferred build alternatives. Due to a change in planned improvements at Waterlick Road that occurred after completion of the no-build analysis, the following geometric changes were made to the intersection prior to including preferred build conditions:

- Converted back to a single westbound left-turn lane from Timberlake Road to southbound Waterlick Road
- Converted back to a single eastbound left-turn lane from Timberlake Road to northbound Waterlick Road
- Updated the eastbound/westbound left signal phasing from protected only, to protected/permissive

Traffic Analysis Results

The same measures of effectiveness used to evaluate no-build conditions were used to measure the quantitative performance of the build Synchro model:

- Average vehicle delay by movement, approach, and intersection – measured in seconds per vehicle
- Maximum queue length – measured in feet

Delay and Level of Service

Synchro was used to calculate the delay and associated LOS at each study area intersection under build conditions. The same methodologies used to analyze no-build conditions were also used to analyze build conditions. HCM 2000 and 2010 methodologies were used to analyze all intersections, as applicable.

The overall intersection delay and LOS for the 11 signalized intersections in the study area is summarized in **Table 15**.

TABLE 15 – FUTURE (2030) SIGNALIZED DELAY AND LOS

Signalized Intersection (reference #)	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1. Timberlake Road at Waterlick Road	62.5	E	72.0	E
2. Timberlake Road at Brush Tavern Drive	*	*	*	*
4. Timberlake Road at Crowell Lane	5.9	A	7.6	A
5. Timberlake Road at McDonalds / Southwood Village	16.3	B	25.8	C
8. Timberlake Road at Big Lots/Carpet One Entrance	40.7	D	20.7	C
11. Timberlake Road at Enterprise Drive/Oakdale Circle	46.0	D	28.5	C
12. Timberlake Road at Greenview Drive	29.7	C	26.4	C
13. Timberlake Road at Laxton Road	42.5	D	31.1	D
17. Timberlake Road at Candlewood Court	10.1	B	6.0	A
19. Timberlake Road at Old Graves Mill Road/Dreaming Creek Drive	25.8	C	38.0	D
29. Timberlake Road at Richland Drive/Leesville Road	38.2	D	26.9	C
Total Delay	317.7	N/A	283.0	N/A

*Traffic signal converted to an unsignalized, median rcut.

Under the preferred build conditions, all signalized intersections operate at LOS D, or better, for both peak hours with the exception of Waterlick Road. Corridor-wide delays are reduced by over 30% and 40% during the AM and PM, respectively, when compared to no-build. This improvement in delay considers the removal of a signalized intersection at Brush Tavern Drive and reverting the previously planned dual turn lanes at Waterlick Road to the currently planned single turn lane. While pockets of congestion will still occur throughout the corridor, these recommendations will result in substantial reductions in delay for key movements at Enterprise Drive, Greenview Drive, and Laxton Road. At Old Graves Mill Road and Leesville Road, the Timberlake Road through movement was operating at LOS E under no-build. With the proposed improvements, the delay is reduced to LOS D, or better (in addition to substantial reductions in delay for movements from Old Graves Mill Road and the westbound left to Leesville Road).

Approach delay and LOS by movement for the 18 unsignalized intersections in the study area is summarized in **Table 16**.

TABLE 16 – FUTURE (2030) UNSIGNALIZED DELAY AND LOS

Unsignalized Intersection (reference #)	Movement	AM Peak Hour		PM Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2. Timberlake Road at Brush Tavern Drive	Southbound R	9.3	A	10.5	B
	Northbound R	10.9	B	11.4	B
3. Timberlake Road at Tomahawk Drive	Southbound R	9.6	A	10.8	B
	Northbound R	10.3	B	10.3	B
6. Timberlake Road at Sunny Bank Drive	Southbound R	*	*	9.7	A

Unsignalized Intersection (reference #)	Movement	AM Peak Hour		PM Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
7. Timberlake Road at Powtan Drive	Northbound R	10.9	B	9.7	A
	Southbound	12.9	B	15.5	C
9. Timberlake Road at Shelor Drive	Northbound	10.2	B	11.1	B
	Southbound R	9.5	A	9.9	A
10. Timberlake Road at Beechwood Drive	Northbound R	10.7	B	10.1	B
	Southbound R	9.7	A	9.8	A
14. Timberlake Road at Wood Road	Northbound R	*	*	9.9	A
	Southbound	934.9	F	1171.6	F
15. Timberlake Road at Knollwood Townhomes/Putt Putt Entrance	Northbound	*	*	302.2	F
	Southbound R	9.8	A	10.2	B
16. Timberlake Road at Charlie's Chicken/Hooper Plumbing Supply Entrance	Northbound R	18.1	C	15.8	C
	Southbound	*	*	*	*
18. Timberlake Road at TGI Friday's/Bojangles Entrance	Northbound	*	*	15.3	C
	Southbound R	9.0	A	9.9	A
20. Timberlake Road at Hedges Insurance Agency Entrance	N/A				
	Southbound	11.3	B	13.5	B
21. Timberlake Road at Oakmont Circle	N/A				
	Southbound R	11.3	B	14.9	B
22. Timberlake Road at Roundelay Road	Northbound R	10.0	B	10.3	B
	Southbound	42.6	E	114.5	F
	Northbound L	37.6	E	85.3	F
	Northbound R	0.0	A	0.0	A
23. Timberlake Road at Timber Ridge Apartments Entrance	Southbound R	11.0	B	13.4	B
	Northbound R	13.8	B	13.7	B
24. Timberlake Road at Timber Ridge II Apartments Entrance	N/A				
	Northbound R	14.0	B	14.1	B
25. Timberlake Road at Whitten Timberlake Chapel Entrance	Southbound	29.3	D	45.5	E
	Northbound	*	*	*	*
26. Timberlake Road at Heritage Business Center Entrance	Southbound R	11.3	B	13.3	B
	Northbound R	14.4	B	13.6	B
27. Timberlake Road at Misty Mountain Road	Southbound R	11.3	B	12.7	B
	Northbound R	21.0	C	16.0	C
28. Timberlake Road at Middleview Street	Southbound R	9.5	A	9.3	A
	Northbound R	*	*	13.7	B

*No movement captured during the peak hour.

Under preferred build conditions, only three (3) intersections had movements that operate at LOS E, or worse, down from 15 under no-build. This is primarily the result of the implementation of RCUT treatments and median closures that restrict northbound and southbound left turns onto Timberlake Road. These movements must turn right and make a u-turn at the next median opening or signalized intersection. During field observations, drivers were observed making an initial right turn, then making a u-turn, rather than waiting for a gap in traffic to make the left-turn movement. Therefore, the extensive application of various median modifications along Timberlake Road will not create unfamiliar movements to many drivers. **Figure 20** illustrates the LOS and delay by movement and total intersection at each location.

Queuing

Under the preferred build conditions, queuing that fills or extends beyond the available storage, or the turn lane access is blocked by adjacent through traffic queuing is projected at the following locations for at least one peak hour:

- Waterlick Road (int. #1): eastbound left and westbound left (blocked by queuing on Timberlake Road and/or extend beyond available storage), southbound approach (all lanes extend beyond available storage and/or are blocked by queuing on Waterlick Road)
- Crowell Lane (int. #4): eastbound and westbound left and right (blocked by queuing on Timberlake Road)
- McDonalds/Southwood (int. #5): westbound left and right and eastbound right (blocked by queuing on Timberlake Road)
- Carpet One/Big Lots (int. #8): eastbound right (blocked by queuing on Timberlake Road), westbound right (blocked by queuing on Timberlake Road), westbound left exceeds storage but for only 2% of the time
- Enterprise Drive (int. #11): eastbound right (blocked by queuing on Timberlake Road)
- Greenview Drive (int. #12): eastbound left (blocked by queuing on Timberlake Road), and northbound right (extends beyond storage and blocked by queuing on Timberlake Road)
- Laxton Road (int. #13): eastbound left and right (blocked by queuing on Timberlake Road), westbound left and right (blocked by queuing on Timberlake Road)
- Candlewood Court (int. #17): westbound left (blocked by queuing on Timberlake Road)
- Old Graves Mills Road (int. #19): southbound right and left are blocked by individual lane queuing on Old Graves Mill Road, and westbound left and eastbound right (blocked by queuing on Timberlake Road)
- Leesville Road (int. #29): eastbound left and right (blocked by queuing on Timberlake Road), and southbound shared through/right blocked by individual lane queuing on Richland Drive.

While queuing is reduced under preferred build conditions, it will likely continue to be a challenge for the corridor because right-of-way constraints limit the ability to add capacity in certain areas. However, where recommendations are implemented, queues for turn lanes are generally confined to the recommended storage lengths and not blocked by queues on Timberlake Road. In fact, queues *on* Timberlake Road under preferred build conditions are reduced by over 40% at Leesville Road, 50% at Old Graves Mill Road, and over 30% between Enterprise Drive and Laxton Road.

Figure 21 illustrates existing queuing along the corridor. The delay/LOS and queuing reports for all locations, including individual movements, is included in **Appendix E**.

FIGURE 20 A – BUILD (2030) LOS AND DELAY

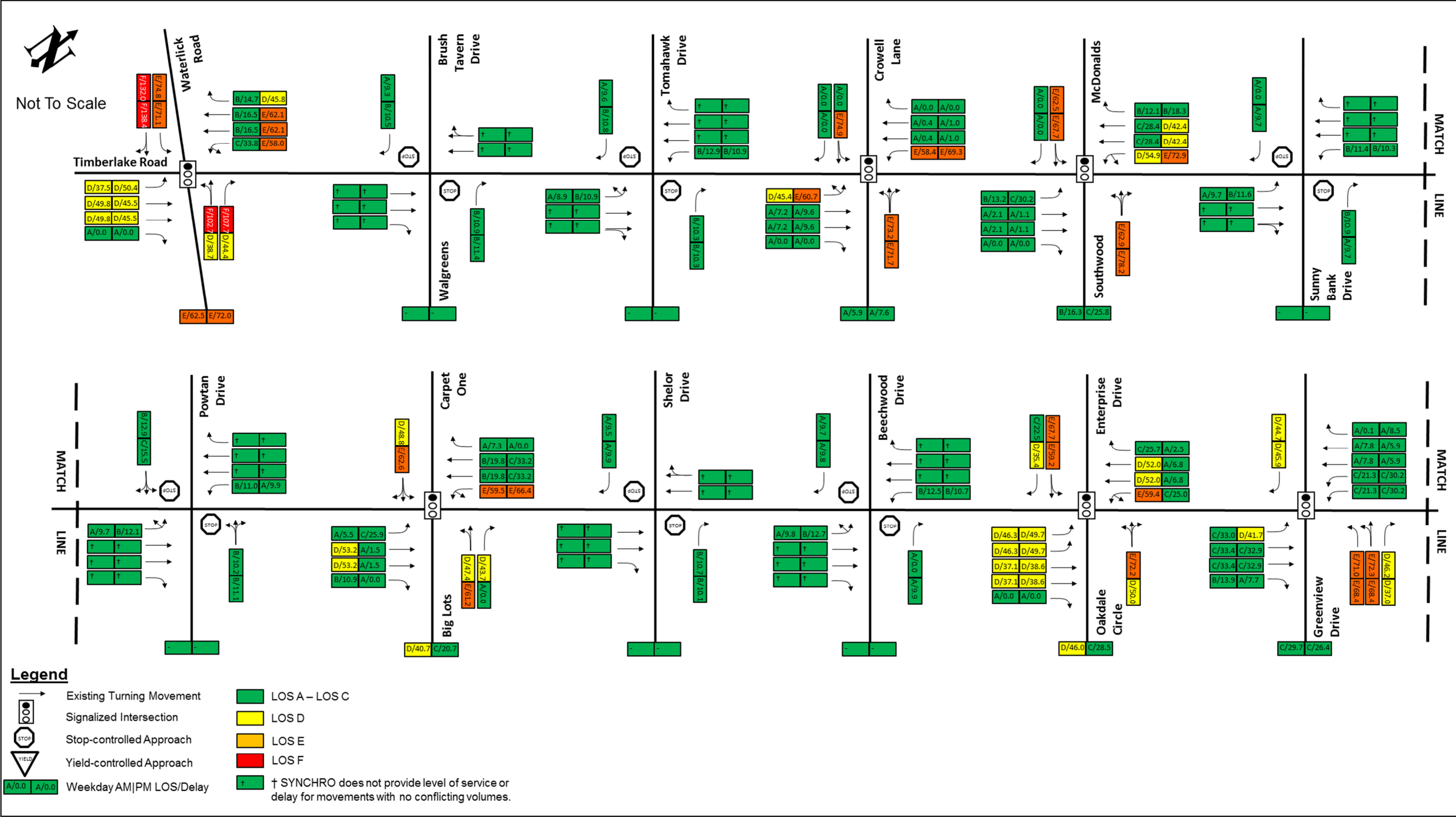


FIGURE 20 B – BUILD (2030) LOS AND DELAY

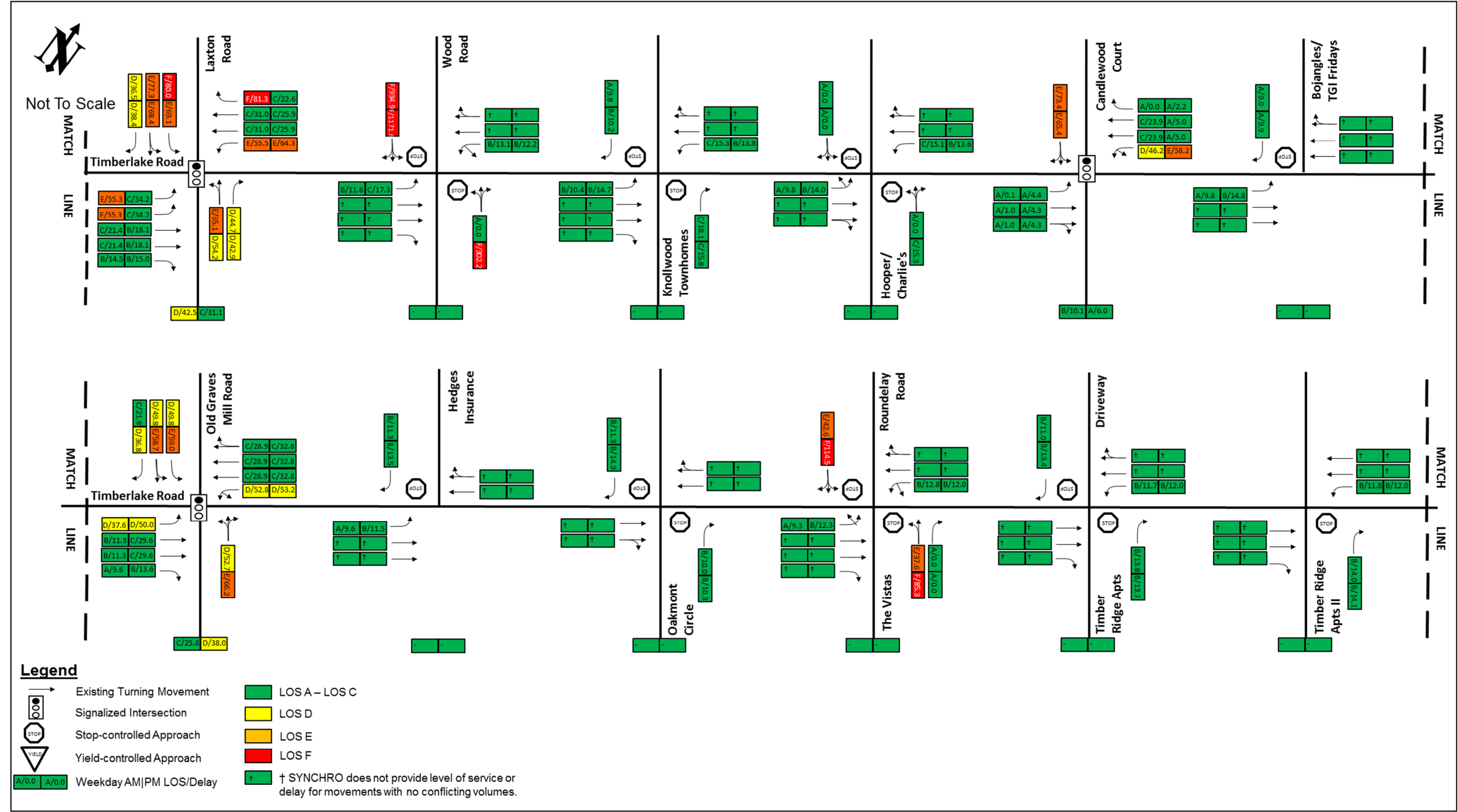


FIGURE 20 C – BUILD (2030) LOS AND DELAY

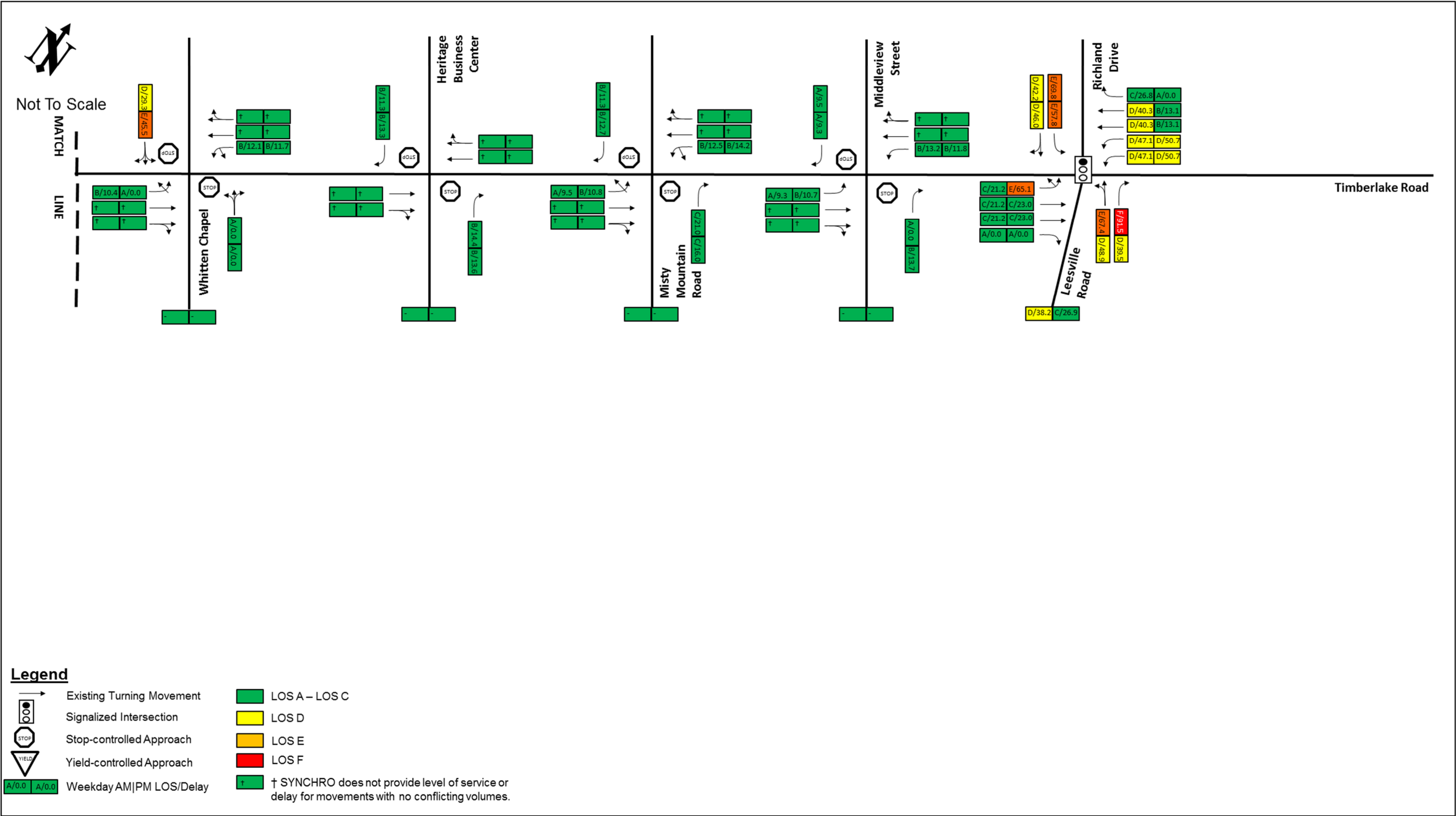


FIGURE 21 A – BUILD (2030) QUEUING

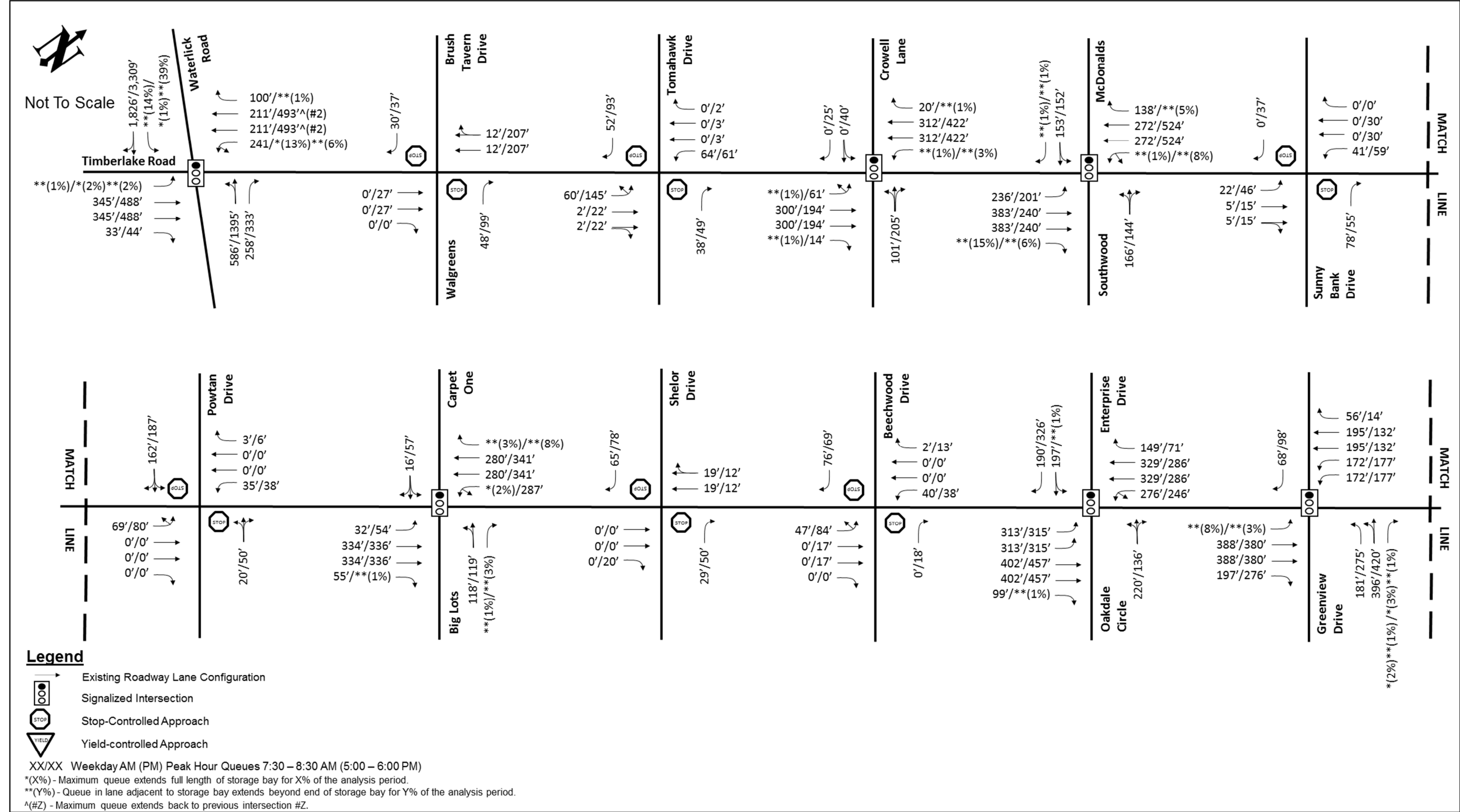


FIGURE 21 B – BUILD (2030) QUEUING

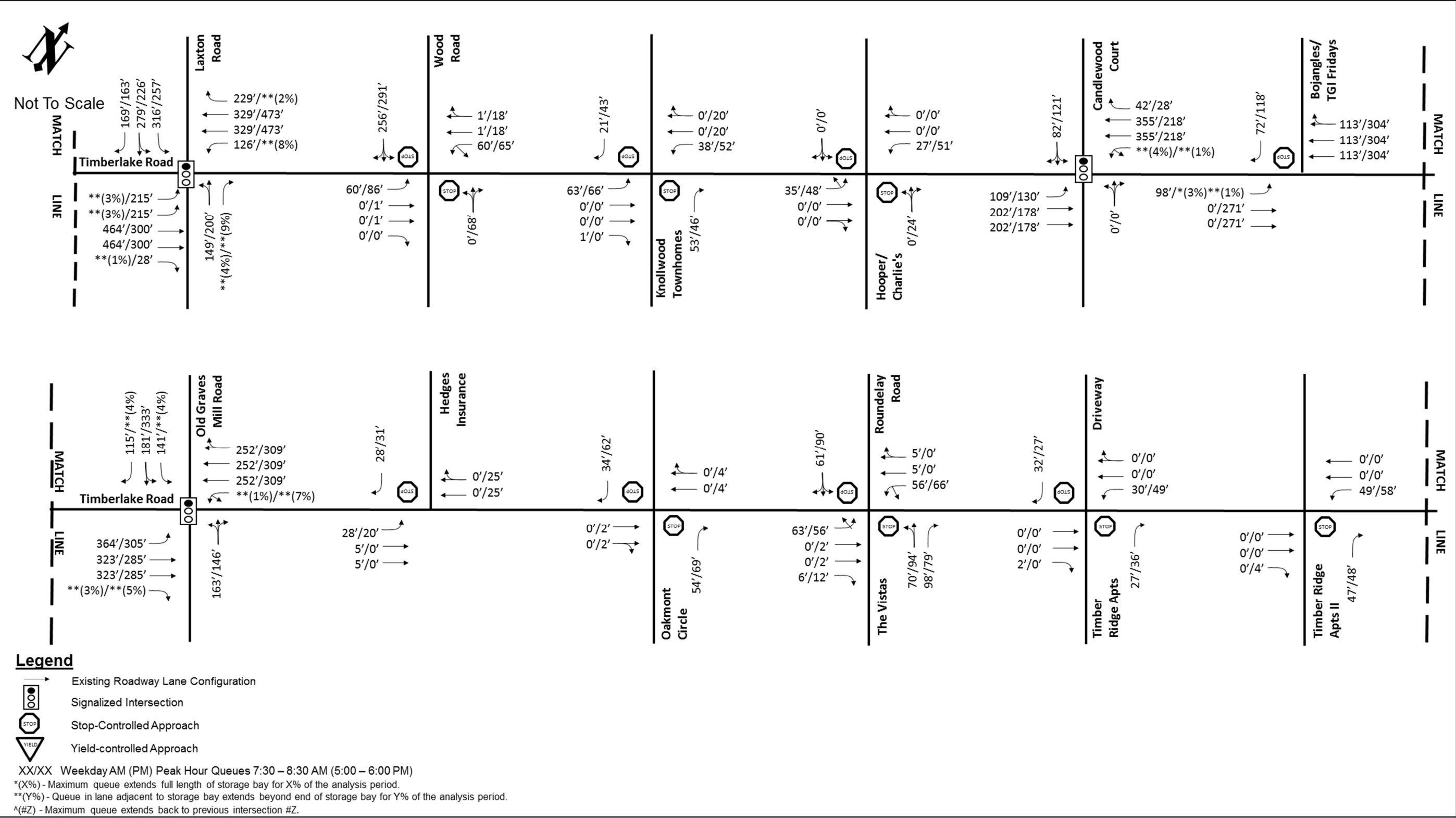
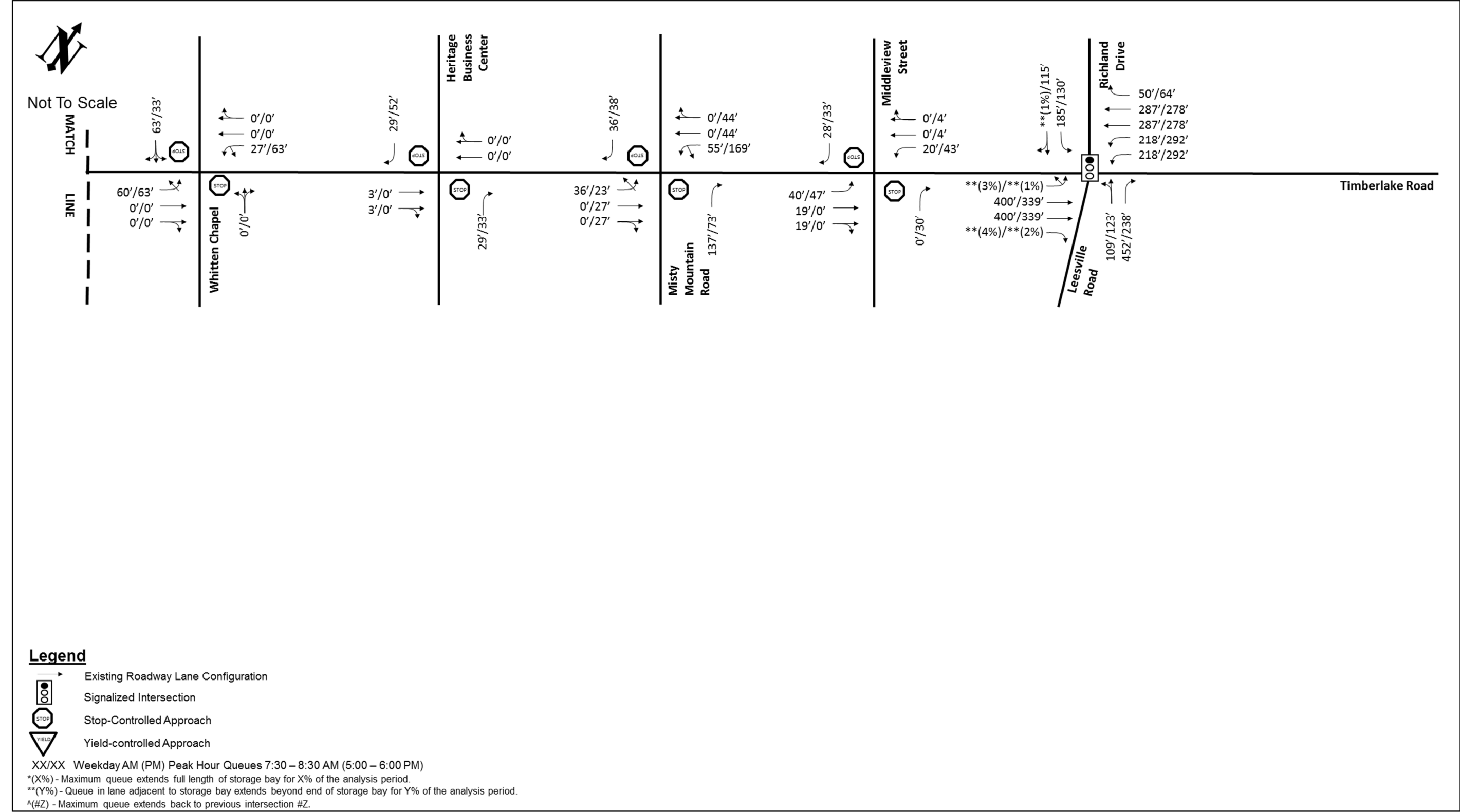


FIGURE 21 C – BUILD (2030) QUEUING



Conceptual Design, Costs, and Schedules

Conceptual designs, planning-level cost estimates, and schedule estimates were developed for each selected improvement project. A sketch of each selected improvement project is included in **Appendix F**. One-page summary sheets were developed for each project and are provided in **Appendix G**. Each summary sheet includes a project description, project sketch, location map, planning-level cost estimate, schedule estimate, and a summary of the projected operations and safety benefits.

Conceptual Design

Conceptual designs were developed in MicroStation for improvement projects along the Timberlake Road corridor in accordance with the following applicable guidelines:

- A Policy on Geometric Design of Highways and Streets (AASHTO 2011)
- VDOT Road Design Manual (Issued January 2005, Revised July 2016)
- VDOT Road and Bridge Standards (VDOT 2016, latest revisions)
- Manual on Uniform Traffic Control Devices (MUTCD 2009)
- 2011 Virginia Supplement to the MUTCD

Design criteria and guidance from these documents were applied to roadways within the project limits based on functional classification and roadway design speeds. All single-lane left-turn movements were designed to accommodate the turning radius for a WB-67 vehicle. All dual-lane left-turn movements were designed to accommodate two concurrent turning vehicles – a SU-40 in the inside lane and a WB-67 in the outside lane.

Pedestrian crosswalks were designed across various side streets within the project limits. However, no crosswalks were designed across Timberlake Road. Should crosswalks be designed during the PE phase, a pedestrian refuge may be needed and will need to be designed at a minimum of six feet wide; however, the existing median widths at several locations are narrower than six feet. The minimum width for the pedestrian refuge can be obtained by narrowing lane widths by up to one foot. Design to this level of detail was not included in the conceptual design drawings.

Curb Ramps (Std. CG-12) are shown at each side street, however they were not included across each public/private entrance. A detailed curb ramp design was not included in the conceptual design drawings; however, a curb ramp cost is included within the sidewalk cost for each improvement.

Planning-Level Cost Estimates

A refined planning-level cost estimate, in 2018 dollars, was developed for all selected improvement projects. A 20 percent preliminary engineering (PE) cost was estimated as a percentage of construction costs, including contingency. For projects with anticipated right-of-way and/or utility impacts, right-of-way and utility relocation costs were estimated on a project-by-project basis based on the size and complexity of the project, as well as the existing right-of-way limits. Construction (CN) costs were estimated using a combination of PCES, the 2015 version of Transportation and Mobility Planning Division Statewide Planning Level Cost Estimate Spreadsheet, and recent bid costs. In addition, the construction cost included an additional 20 percent contingency of the base roadway construction cost, 20 percent for construction engineering and inspection (CEI), and a five percent incentive.

Table 17 summarizes the preliminary engineering (PE); right-of-way and utility relocation (RW); construction (CN); and total planning level cost estimates for each improvement project. A more detailed breakdown of the planning-level cost estimates is provided in **Appendix H**.

TABLE 17 – PLANNING-LEVEL COST ESTIMATES

Improvement	Cost Estimate (2018 dollars)			
	PE	RW	CN	Total
Brush Tavern Drive to Crowell Lane	\$442,000	\$677,000	\$2,422,100	\$3,541,100
Sunny Bank Drive	\$401,000	\$297,000	\$2,206,100	\$2,904,100
Shelor Drive to Enterprise Drive	\$828,000	\$200,000	\$4,511,700	\$5,539,700
Greenview Drive to Laxton Road	\$1,400,000	\$1,351,000	\$7,595,400	\$10,346,400
Wood Road to Hooper/Charlie's Entrance	\$736,000	\$647,000	\$4,048,000	\$5,431,000
Bojangles/TGI Fridays Entrance to Roundelay Road	\$1,100,000	\$2,103,000	\$5,997,900	\$9,200,900
Timber Ridge II Apartments Entrance	\$109,000	-	\$605,700	\$714,700
Whitten Timberlake Chapel Entrance to Heritage Business Center Entrance	\$240,000	\$246,000	\$1,326,200	\$1,812,200
Middleview Street to Leesville Road	\$611,000	\$500,000	\$4,345,400	\$5,456,400

Schedule Estimates

Schedule estimates were developed for all selected improvement projects in coordination with the SWG. **Table 18** summarizes the projected timeframes for the PE; RW; and CN phases of each improvement project.

TABLE 18 – SCHEDULE ESTIMATES

Improvement	Schedule Estimate (months)			
	PE	RW	CN	Total
Brush Tavern Drive to Crowell Lane	18	12	8	38
Sunny Bank Drive	18	6	8	32
Shelor Drive to Enterprise Drive	18	6	10	34
Greenview Drive to Laxton Road	18	18	12	48
Wood Road to Hooper/Charlie's Entrance	18	12	10	40
Bojangles/TGI Fridays Entrance to Roundelay Road	18	18	12	48
Timber Ridge II Apartments Entrance	6	0	4	10
Whitten Timberlake Chapel Entrance to Heritage Business Center Entrance	12	6	6	24
Middleview Street to Leesville Road	18	12	10	40

Project Advancement

This Study should be used as a planning tool to achieve the next steps of planning, programming, designing, and constructing the identified safety and operational improvements in the study corridor. To build upon the efforts of this Study, the Study Work Group and other stakeholders should continue to coordinate as further developments are made along the Timberlake Road corridor and reevaluate the proposed projects from this Study as necessary. To advance these projects beyond the planning stage, members of the SWG should take the following steps:

Prepare Projects for Advancement

Outreach meetings should be conducted for further vetting of the proposed projects, as needed. These outreach meetings should include additional stakeholders that were not in the SWG. Other stakeholders may include business owners on the corridor and area residents.

Improvement projects should be prioritized on a local and regional level. Prior to submitting funding applications, applicant must have one of the following:

1. Inclusion or proven consistency with the Constrained Long-Range Transportation Plan (CLRP)
2. Resolution of support from governing body

Apply for Funding

The following funding sources should be considered for improvement projects identified in this Study.

- Revenue Sharing – a program that provides a dollar for dollar state match to local funds for transportation projects. Projects eligible for Revenue Sharing funds include construction, reconstruction, improvement, and maintenance projects. All improvement projects are candidate projects for Revenue Sharing.
- Congestion Mitigation and Air Quality (CMAQ) – a program that allocates funding to surface transportation projects that improve air quality by reducing congestion. All improvement projects are candidate projects for CMAQ.
- Highway Safety Improvement Program (HSIP) – a program that provides funding for improvements that correct or improve safety on a section of roadway or intersection with a high incidence of crashes. All improvement projects are candidate projects for HSIP.
- SMART SCALE – a program that allocates funding from the construction District Grants Program (DGP) and High-Priority Projects Program (HPPP) to transportation projects. SMART SCALE uses a scoring process that evaluates, scores, and ranks project applications based on six measures: congestion mitigation, economic development, accessibility, safety, environmental quality, and land use. All proposed projects included in this Study are eligible for SMART SCALE funding.